McMillan, P.D., A.H. Blackwell, C. Blackwell, and M.A. Spencer. 2013. The vascular plants in the Mark Catesby collection at the Sloane Herbarium, with notes on their taxonomic and ecological significance. Phytoneuron 2013-7: 1–37. Published 28 January 2013. ISSN 2153 733X

THE VASCULAR PLANTS IN THE MARK CATESBY COLLECTION AT THE SLOANE HERBARIUM, WITH NOTES ON THEIR TAXONOMIC AND ECOLOGICAL SIGNIFICANCE

PATRICK D. MCMILLAN
School of Agriculture, Forestry, and the Environment
Clemson University
Clemson, South Carolina

AMY HACKNEY BLACKWELL
School of Agriculture, Forestry, and the Environment
Clemson University
Clemson, South Carolina
Corresponding author: amyblackwell@mac.com

CHRISTOPHER BLACKWELL
Department of Classics
Furman University
Greenville, South Carolina

MARK A. SPENCER
Natural History Museum
Cromwell Road
London SW7 5BD, UK

ABSTRACT

We provide a list of all vascular plant specimens collected in the Carolinas and Georgia by Mark Catesby that are housed in the Sloane Herbarium at the Natural History Museum, London. We present the identifications along with notes on the significance of selected specimens. We also describe the process of digitizing the specimens and discuss the potential benefits of an integrated digital library of historical botany. Catesby's specimens provide insight into the nature of the flora of the Carolinas and Georgia prior to extensive modification by European immigrants. Through comparison with modern ranges these plants may help to shed light on the routes that Catesby might have travelled as well as pinpointing some areas that he visited. They also serve as a good reference for assessing the native ranges of several problematic taxa. Catesby's specimens are of special interest due to their taxonomic relevance when viewed as supporting material for the color plates contained in Catesby's two-volume *Natural History of Carolina, Florida and the Bahama Islands*, which was extensively cited by Linnaeus. The availability of high-quality digital images through the *Botanica Caroliniana* website (folio.furman.edu/botcar) will aid additional researchers and should spawn future research in natural sciences and historical disciplines.

KEY WORDS: Catesby, herbarium, historic botany, ecology, South Carolina, digital imaging, Creative Commons, open source

Mark Catesby[1] was born in England on March 24, 1682 or 1683 and studied natural history in London as a young man. In 1712 he made his first trip to America, visiting his sister and her husband in Virginia. He stayed in Virginia for several years, collecting and sending plants to England and visiting Jamaica in 1715. After returning to England in 1719 he met Sir Hans Sloane, President of the Royal Society and of the College of Physicians. With financial backing from Sloane, William Sherard, Charles Dubois, and several others, Catesby sailed to "Carolina" in 1722 under orders to study the plants native to the region (Allen 1937). During the next four years he periodically sent dried and living plant specimens to his patrons in England. He spent at least nine months in the Bahamas in 1725 and 1726 and then returned to England in 1726 to begin work on his *Natural History*, doing his own painting and engraving. He published the first portion of the *Natural History* in 1729 and periodically added sections to it until he completed it in 1747 (Reveal 2012).

Many of Catesby's dried plant specimens from the Carolinas, Georgia, and the Bahamas ended up in the possession of Sir Hans Sloane, forming part of the original collections of the Natural History Museum in London. Others were sent to Sherard and are currently housed in the Sherard and Dubois herbaria at the University of Oxford (Reveal 2012; Stephen Harris, Druce Curator of Oxford Herbaria, pers. comm. 2012)[2]. The Sloane materials were bound into two volumes, *Herb. Sloane* (H.S.) 212 and H.S. 232, which are currently housed in the Sloane Herbarium (Dandy 1958).

Catesby's *Natural History of Carolina, Florida, and the Bahama Islands* was one of the first works to describe the flora and fauna of a region of the Americas. The two volumes of the work include 220 engraved plates depicting plants and animals that Catesby found.[3] In the text, Catesby describes the people and places he encountered, including collection trips into the "upper parts" of the country, toward the mountains, during which he employed a Native American to carry his box of painting materials and dried plant specimens (see *Natural History*, 1-8). For each plate, he provided a description of the species in question, including size, habitat, and traditional uses when known. Catesby apologized for his deficits as a painter but noted that he always worked from freshly gathered plants and hoped that his careful, measured drawings would be more useful to natural history than images rendered "in a more bold and Painter like way" (see *N.H.* 1-11). Of his plant identifications, he wrote "As to the Plants I have given them the English and Indian names they are known by in these countries: And for the Latin Names I was beholden to the above-mention'd Learned and accurate Botanist Dr. Sherard" (see *N.H.*, 1-12).

The publication of the *Natural History* was a significant event in the scientific community. Catesby published his first volume in installments between 1729 and 1732 (Reveal 2012). He was

---

[1]Catesby's life and work have been well described by a number of authors, including Catesby himself in the preface to his *Natural History*, Vol. 1. Dandy discussed his life on pp. 110–111 of *The Sloane Herbarium* (1958). Other sources include Elsa Allen's "New Light on Mark Catesby" (1937) and several of James Reveal's articles, especially his 2012 "Nomenclatural Summary" in *Phytoneuron*. Reveal himself recommended Frick and Stearn's *Mark Catesby, the Colonial Audubon* (Frick & Stearns 1961). On the matter of the year of Catesby's birth, controversy persists as to whether he was born in 1682 (Allen's contention) or 1683 (Reveal's).

[2]Catesby sent the specimens currently housed at Oxford University to Sherard, who organized their mounting and storage. Catesby also corresponded with Dillenius about the specimens after Sherard's death; the letters are stored in the Oxford University Department of Plant Sciences along with the herbarium specimens.

[3]There were several editions of Catesby's *Natural History* published in the 1700s, and it has been republished many times into the 20th Century. For this paper we consulted the digital facsimile of the 1754 edition made available by the University of Wisconsin Library's *Digital Library for the Decorative Arts and Material Culture*: <http://digicoll.library.wisc.edu>.

elected a fellow of the Royal Society in 1733 on the strength of his first volume on American plants and animals (Allen 1937). Carl Linnaeus cited a number of Catesby's plates while describing some North American species and varieties in his *Species Plantarum*; Dandy (1958) discussed the types on p. 112, and Reveal (2009, 2012) has given a comprehensive list of types derived from Catesby's work. Reveal provisionally selected eight specimens as types for the Linnaean Plant Name Typification Project in 1989 (see below). Although other subsequent botanists referred to some of Catesby's herbarium specimens in their work, Linnaeus appears not to have examined Catesby's actual dried plants (Dandy 1958). This is rather unfortunate. Catesby's dried material is, in many cases, of excellent quality, often with large portions of the plant and flowering and fruiting material included (see Fig. 1 –TOXICODENDRON VERNIX H.S. 212 f. 25), in sharp contrast to that of many other collectors of the day, who constrained their collections to fragmentary specimens often in much poorer condition.

Catesby's *Natural History* has been well studied. Richard Howard, former director of the Arnold Arboretum, visited the Sloane Herbarium in 1982 to verify the identities of specimens in H.S. 212 and H.S. 232 that appear in the Natural History (Howard & Staples 1983). James Reveal revisited the *Natural History* in 2009, comparing the plates with Catesby's original watercolors, currently held in the Royal Library at Windsor Castle, England, to further refine the determination of plant species (Reveal 2009).

Catesby's *Horti Sicci* in the Sloane Herbarium, however, have not been nearly as well studied as the *Natural History* plates. There exists no comprehensive publication of recent determinations of these specimens. Howard and Staples (1983) does not contain determinations of plants that do not appear in the *Natural History*. The collections have been well cared for but relatively inaccessible to scholars who cannot travel to London or whose time there is limited.

Our project, *Botanica Caroliniana*, is working to make these dried plant specimens and others freely available and easy to discover and use. The project in digital imaging that produced the images of Catesby's *Horti Sicci* is a collaboration by scholars from Clemson University, Furman University, and the Natural History Museum, London, to digitize the herbarium collections of the first naturalists to study the botany of the Carolinas: Mark Catesby, Robert Ellis, John Lawson, John and William Bartram, James Oglethorpe, and Thomas Walter. We secured 2,000 images of plants, some collected as early as 1710, which are now released under an open-content license. All of Catesby's collections in the Sloane Herbarium are now online.

Using the digital images and first-hand examination of the material in the Sloane Herbarium we have made a determination of every specimen in H.S. 212 and H.S. 232. The fact that the images are online allows us to revisit them as many times as we wish, to zoom in on details, and to compare specimens to one another and to the digital images of Catesby's *Natural History*.[4]

Having all these specimens available digitally has allowed us to make a number of observations on Catesby's work that would have been prohibitively difficult if we had to rely on periodic visits to London, which was previously the only way to see all of Catesby's Sloane specimens. The specimens in the Sloane herbarium are well-preserved and not fragmentary, allowing examination of the tiniest details. Some are strikingly beautiful. Because certain species occur today

[4]Reveal's own recent work is a good illustration of the value of digital collections. In his 2009 article he listed a number of digital publications of Catesby's work and Linnaean type specimens that assembled a huge amount of far-flung documents online and made possible a project that even just a few years earlier would have been prohibitively difficult if not impossible (Reveal 2009).

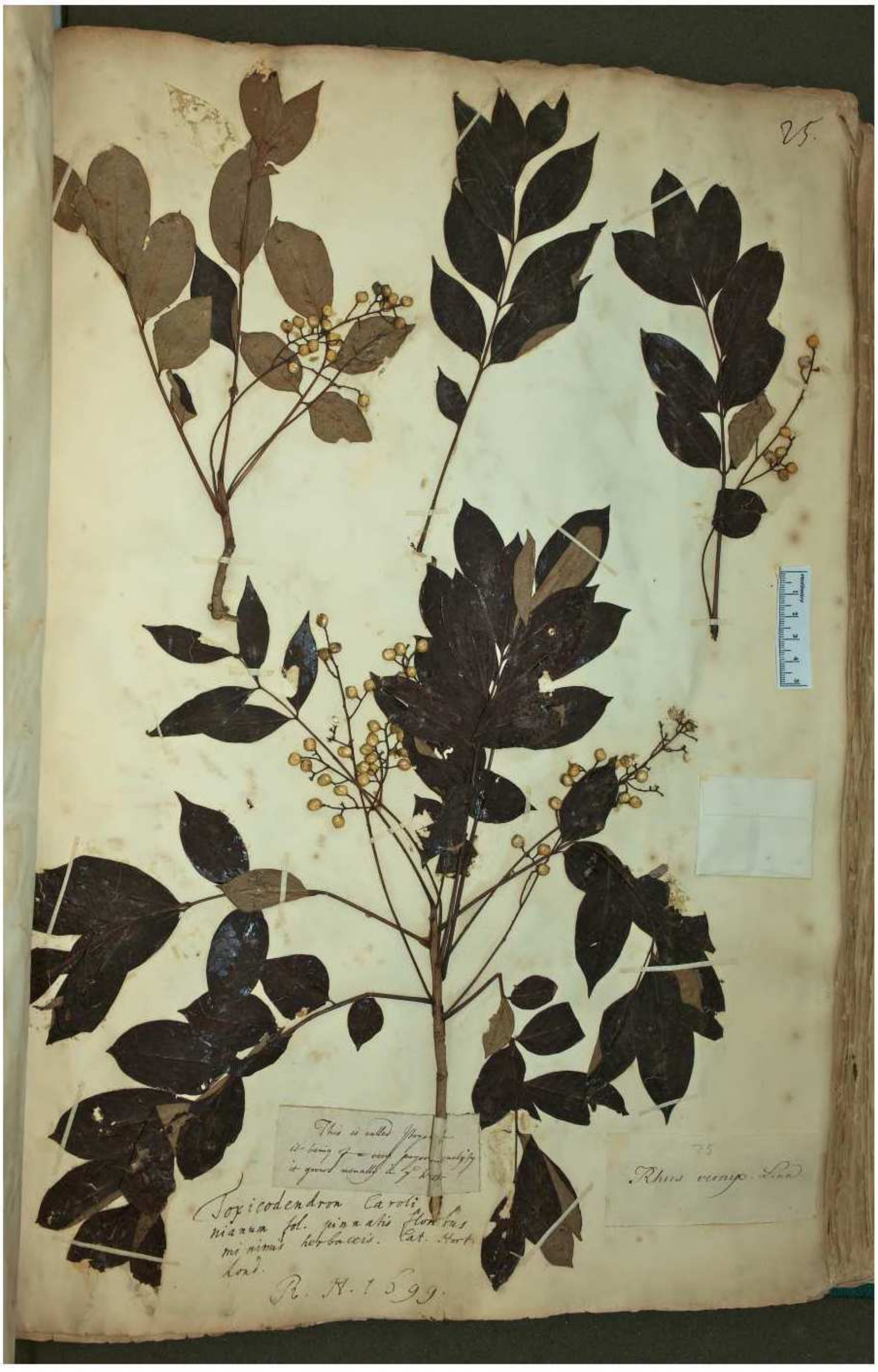

Figure 1. Catesby H.S. 212 f. 25. *Toxicodendron vernix* (L.) Kuntze. Access this image online by its canonical address: <http://folio.furman.edu/citeimg/urn:cite:fufolioimg:Caroliniana.Catesby_HS212_025_0488>. The archive of all Catesby images is at: <http://amphoreus.hpcc.uh.edu/botcar/>.

only in very restricted areas, the collections provide some clues as to where Catesby must have traveled during his time in Carolina. The specimens also shed light on the typification of several taxa and raise the possibility that there is still some work to be done in this area. Catesby's notes and the other data provide insights into 18th century pharmacological science, horticultural trends, and presumed native range. The other metadata, including various labels added by other scholars over the past three centuries, could provide ample material for further scholarship in both historical botany and its relationship to modern ecology.

Our examination of Catesby's collections left us in awe at the sheer variety of habitats he visited and the large number of rare or uncommon species that would remain obscure or uncollected for a very long period after his visit that he included in his collections. Many among us today would not recognize *Litsea aestivalis* (L.) Fernald or be able to locate *Delphinium carolinianum* Walter or *Astragalus michauxii* (Kuntze) F.J. Herm. Catesby perceived very small differences in morphology between numerous species of confusingly similar *Liatris*. He was a true explorer.

Methods

The digitization project is part of an ongoing process of research in longitudinal alignment of image collections, supported by a National Science Foundation Grants No. 0916148 & No. 0916421. We visited the Natural History Museum in London on November 16 and 17, 2011. Our equipment was various: two Nikon DSLRs, a portable conservation copy stand, a tripod, weights to counterweight the camera on the tripod, several foam wedges to support large volumes, two iPads, a MacBook Pro, and a MacBook Air. With this (relatively) portable array of equipment, we were able to set up two parallel imaging stations. We used the copy stand to image smaller bound volumes and flat sheets. We set up the foam wedges on a table to support the larger volumes and used the tripod to hold the camera above them. One of the authors of this paper, Mark Spencer, Senior Curator of the British and Irish Herbarium of the Natural History Museum, London, provided volumes of herbarium specimens from the Sloane Herbarium as the work progressed.

With both cameras mounted overhead and tethered to the laptops, we drove them remotely using wireless connections between the laptops and the iPads, and the iOS app *DSLRCamera-RemoteHD*. This setup provided us flexibility, efficiency, and security. The iPads could be moved anywhere in the room. The iOS app provided "live view" through the camera's lenses and controlled all major photographic settings—and was utterly reliable and considerably more polished than Nikon's MacOS X software. The images were saved directly onto the laptops' disk drives. We stored the images of each herbarium volume in its own directory and periodically backed these up to redundant external hard drives using the Unix utility "rsync."

Using this method we were able to take approximately 2000 high-resolution digital photographs of several herbarium volumes, including detailed shots of some images. We photographed Catesby's two collections of Carolina material, H.S. 212 and H.S. 232. We also photographed these: three collections of John Bartram's material, H.S. 332*, H.S. 334a, and H.S. 334b; William Bartram's Georgia, South Carolina and West Florida, and East West Florida collections; John Lawson's collection, H.S. 145, the so-called Walter Herbarium; and selected specimens collected by Robert Ellis, James Oglethorpe, and John Lawson in H.S. 159, H.S. 158, H.S. 242, and H.S. 316. Though this article is concerned only with Catesby's materials, the other materials will also be freely available online as part of the *Botanica Caroliniana* database; they await only post-processing and the addition of basic metadata.

We used the Nikon D3x and Nikon 18-200mm VR lens to photograph the Catesby specimens. H.S. 212 and H.S. 232 are quite large bound volumes, so we had to use the tripod to put enough distance between camera and page to capture full pages in single shots. Because our time was limited

and our equipment portable, we had to balance speed and volume with "perfection" of images. Our objective was to get photographs that were good enough to allow us to examine as much detail as possible on the specimens. It is impossible to flatten the pages of the bound volumes, which made it impossible to take perfectly square images of them; we have since digitally "flattened" the images to make them square. We kept the apertures relatively small to ensure enough depth of field that the whole page would be in focus while remaining in the middle of the lens' range of f-stops, where lenses are generally sharpest. Shutter speeds ranged from 1/60 to 1/150 of a second, as we were working from stable cameras under good light.

All images were captured in Nikon RAW format and developed using Apple's *Aperture* software. During development we add sharpening, applied correction for white-balance and chromatic aberration (most noticeable at the edges of images), and added metadata.

Through an agreement with the Natural History Museum, all of the project's images are available worldwide under a Creative Commons 3.0 Non-commercial Attribution Share-alike Unported license (creativecommons.org/licenses/by-nc-sa/3.0/). Work on metadata and development of many of the images is ongoing, but we have published the images for the two volumes of Mark Catesby. The unaltered RAW files and developed JPG versions at full resolution and at 50% resolution are available at the project's data-archive, provided by the University of Houston's Center for High Performance Computing (amphoreus.hpcc.uh.edu). The images are also available through an Image Service that follows the protocols defined by the CITE Digital Library Infrastructure, developed by the *Homer Multitext Digital Library* (homermultitext.org; CITE Architecture: folio.furman.edu/projects/cite/index.html). This image service provides an application programming interface (API) for identifying and retrieving images at different scales or versions cropped to specified regions-of-interest. A one-page portal of links to the Catesby Images exposed through the dynamic web view is online at <http://folio.furman.edu/botcar/catesby-images.html>.

To identify the plants, McMillan and Hackney Blackwell set up two laptops side by side. This arrangement allowed us to access the multiple pieces of information we needed: the high resolution images of the plants, published through the CITE Image Service, which allowed us to zoom in on small structures and handwritten notes; the PDF of Weakley's *Flora of the Southern and Mid-Atlantic States* (2012); an online version of Catesby's *Natural History*; other websites such as the PLANTS Database (USDA, NRCS 2013); and a database program (*Bento* from Filemaker) in which we collected and organized our data. We emailed images of problematic specimens to experts in their fields. For example, John Nelson of the University of South Carolina reviewed the image of an indeterminate *Stachys* on H.S. 212 f. 29.

This *ad hoc* "workstation" proved highly effective for collaborative, comparative research and illustrates the need for a research environment that allows flexible, responsive juxtaposition of images toward serendipitous discovery. The development of such an environment based on openly-licensed digital library technologies is one of the immediate aims of this interdisciplinary project.

The excellent condition of the specimens facilitated the process of identification. Catesby's collections in the Sloane are quite well-preserved. The degree of preservation makes it possible to examine some of the tiniest details, such as pubescence, the length of stamens, and even color. H.S. 212 f. 57, for example, contains two specimens from the genus *Lupinus*. On the upper left is *Lupinus diffusus* Nutt. It is so well-preserved that the appressed pubescence of the petiole and the light blue standard with white center are still visible. On the lower center and right is *Lupinus villosus* Willd., on which one can easily see the shaggy pubescence of the petiole as well as the purplish flowers with dark spots at the centers of the standards (see Fig. 2, H.S. 212 f. 57).

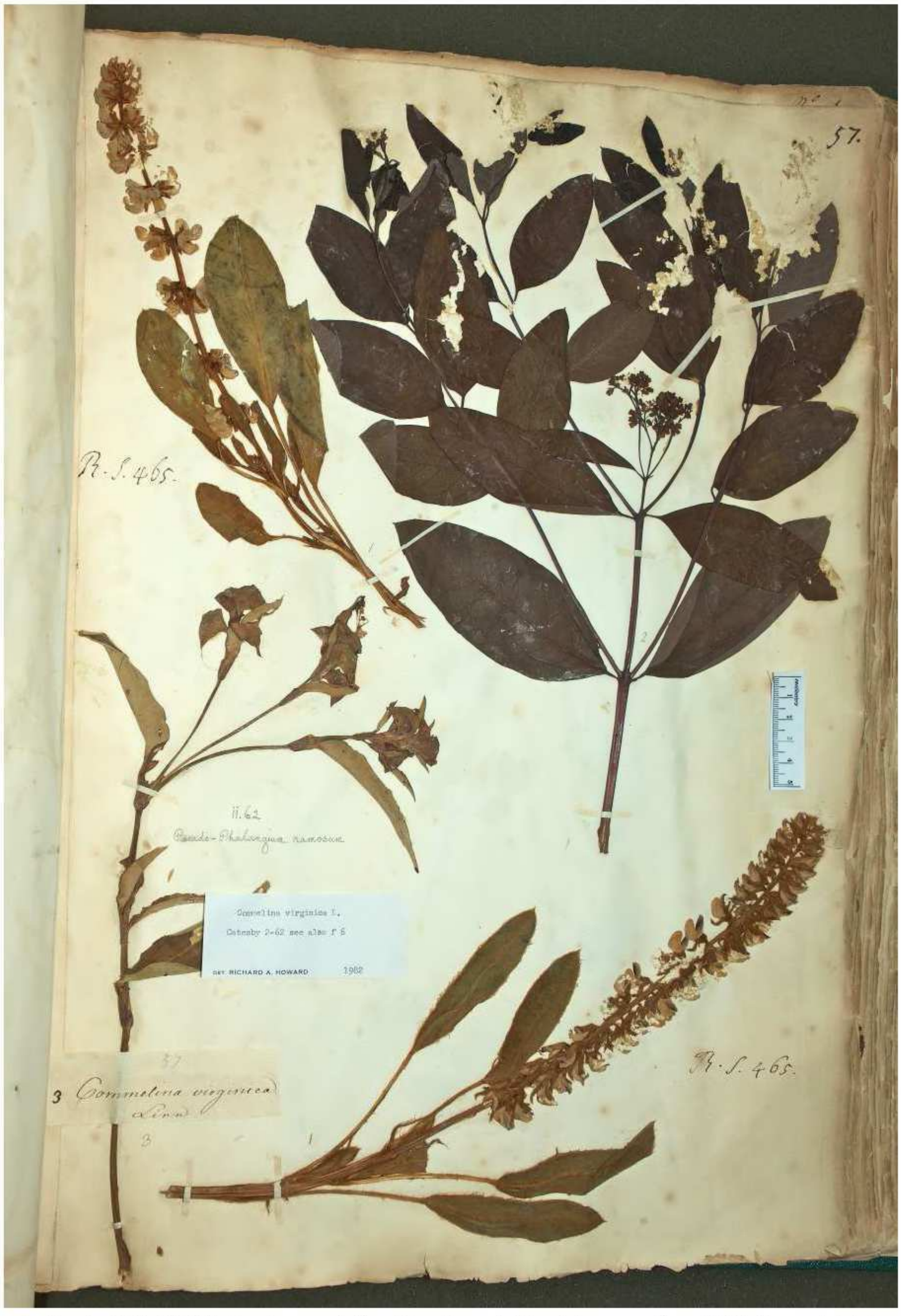

Figure 2. Catesby H.S. 212 folio 57. *Lupinus diffusus* Nutt. (upper left) and *Lupinus villosus* Willd. (lower right). Access this image online by its canonical address: <**http://folio.furman.edu/citeimg/urn:cite:fufolioimg:Caroliniana.Catesby_HS212_057_0437**>. The archive of all Catesby images is at: <**http://amphoreus.hpcc.uh.edu/botcar/**>.

Many folios contain various texts in addition to plant specimens. These include Sir Hans Sloane's handwritten notes, handwritten binomial labels added by Daniel Solander in the 1760s or 1770s, typed identification labels of plants that appear in Catesby's *Natural History* added by Richard Howard in 1982, and a few handwritten descriptions of plants written by Catesby himself and pasted on to the folio pages by someone else (Dandy 1958). We transcribed all of these notations, adding them to the records for each specimen. For each specimen we noted whether it was in flower, fruit, or sterile, which provides some clue as to the time of year it was collected.

Results

We identified 256 collections in H.S. 212 and 167 in H.S. 232. We identified each specimen that could absolutely be assigned to having been collected in "Carolina" or "Georgia." We also identified those that could have been collected in this region but that might instead have been collected in Florida or the Bahamas. We did not identify plants clearly from the Bahamas or nonvascular plants, but the images containing those unidentified specimens are in the full collection of digital images of Catesby's two *Horti Sicci*. 108 identifications in H.S. 212 and 119 identifications in H.S. 232 are original, of specimens that had no recorded previous identifications on the folio pages. Most folio pages contain more than one specimen; we have identified them only by folio page and have not given individual specimens separate identifiers. The folio pages are hand-numbered in the upper right corner. H.S. 212 contains two folio pages numbered 58; we have identified them as H.S. 212 f. 58a and H.S. 212 f. 58b.

We have included prior determinations by several scholars. Many folios contain pasted-on labels in Daniel Solander's distinctive copperplate handwriting. Dandy noted that a large number of specimens "are named by Solander and some are described as new in his MSS" (Dandy 1958). Solander was a student of Linnaeus who moved from Sweden to England in 1760 and became assistant librarian at the British Museum in 1763. From 1768 until his death in 1782 Solander traveled and worked with Sir Joseph Banks, collecting specimens and naming them. He did not publish extensively and died leaving behind a body of manuscript material (Gilbert 2012). Some of Solander's determinations are Linnaean binomials. Others are Latin binomials followed by "Mscr." None of Solander's unpublished names are current scientific names. Unpublished names appear in the species list in quotation marks and are not italicized to distinguish them from published binomials.

Richard Howard attached labels containing identifications to the specimens he examined in 1982 in his work coordinating *Natural History* images with herbarium specimens (Howard & Staples 1983). These labels also contain his cross-references to *Natural History* volumes 1 and 2.

James Reveal marked several specimens with labels for the Linnean Plant Name Typification Project, and we have noted these as well. These were provisionally selected as types in 1989, though ultimately they did not necessarily become Linnaean types. The website for the Linnaean Plant Name Typification project (NHM 2013) contains more information on this topic, as do Reveal's comments in the book *Order Out of Chaos* (Jarvis 2007).

The folio pages contain various other hand-written notes and comments, including Catesby's observations on particular plants, Sloane's notations, and notes in pencil without attribution. We have not included this metadata in this list, but we have transcribed these items to the best of our ability and will publish them online with the images as part of the complete data collection.

List of Specimens

The format for the listing is as follows: Currently accepted species name following Weakley (2012); folio page in H.S. 212 or H.S. 232; name attached to specimen by prior researcher; prior researcher; association with *Natural History* if any.

PTERIDOPHYTES	
Aspleniaceae	
Asplenium trichomanes L.	**H.S. 232 f. 61**
Athyriaceae	
Athyrium asplenioides (Michx.) A.A. Eat.	**H.S. 232 f. 79**, *Polypodium rhoticum* L., *det. in sched.* D. Solander
Blechnaceae	
Woodwardia areolata (L.) T. Moore	**H.S. 232 f. 79**
Dryopteridaceae	
Polystichum acrostichoides (Michx.) Schott	**H.S. 212 f. 82** **H.S. 232 f. 77**, *Polypodium auriculatum* L., *det. in sched.* D. Solander
Lycopodiaceae	
Lycopodiella alopecuroides (L.) Cranfill	**H.S. 212 f. 26**, *Lycopodium alopecuroides* L., *det. in sched.* D. Solander
Osmundaceae	
Osmunda regalis L.	**H.S. 232 f. 77**, *Osmunda regalis* L., *det. in sched.* D. Solander
Selaginellaceae	
Selaginella apoda (L.) Spring	**H.S. 212 f. 41**
Thelypteridaceae	
Phegopteris hexagonoptera (Michx.) Fée	**H.S. 232 f. 78**, *Polypodium phegopteris* L., *det. in sched.* D. Solander
GYMNOSPERMS	
Cupressaceae	
Taxodium ascendens Brongn.	**H.S. 232 f. 69**, *Taxodium ascendens* Brongn. *det. in sched.* R. Howard, associated with *N.H.* 1-11. **H.S. 232 f. 85**, *Taxodium distichum* (L) Rich. *det. in sched. R.* Howard, associated with *N.H.* 1-11
Taxodium distichum (L.) Rich.	**H.S. 212 f. 4**, *Taxodium distichum* (L.) Rich. *det. in sched.* R. Howard, associated with *N.H.* 1-11
BASAL ANGIOSPERMS	
Aristolochiaceae	
Asarum canadense L.	**H.S. 212 f. 58b**, *Asarum canadense* L. *det. in sched.*

Endodeca serpentaria (L.) Raf.	**H.S. 232 f. 122**, *Aristolochia serpentaria* L. *det. in sched.* R. Howard, associated with *N.H.* 1-29; *Aristolochia serpentaria* L. *det. in sched.* J. Reveal; provisionally selected *in sched.* by J. Reveal as typotype of syntype for *Aristolochia serpentaria* L. for Linnaean Plant Name Typification Project
Calycanthaceae	
Calycanthus floridus L.	**H.S. 212 f. 16**, *Calycanthus floridus* L., *det. in sched.* D. Solander; *Calycanthus floridus* L. *det. in sched.* R. Howard, associated with *N.H.* 1-46, identified by Reveal for Linnaean Plant Name Typification Project
Lauraceae	
Litsea aestivalis (L.) Fern.	**H.S. 232 f. 35**
Persea borbonia (L.) Spreng.	**H.S. 232 f. 50**
Persea palustris (Raf.) Sarg.	**H.S. 212 f. 1**, *Persea borbonia* (L.) Sprengel *det. in sched.* R. Howard, associated with *N.H.* 1-63
Magnoliaceae	
Liriodendron tulipifera L.	**H.S. 212 f. 80**, *Liriodendron tulipifera* L. *det. in sched.* R. Howard, associated with *N.H.* 1-48
Nymphaeaceae	
Nymphaea odorata Ait.	**H.S. 212 f. 23**, *Nymphaea alba* L., *det. in sched.* D. Solander. **H.S. 232 f. 84**
Saururaceae	
Saururus cernuus L.	**H.S. 232 f. 82**, *Saururus cernuus* L., *det. in sched.* D. Solander
MONOCOTS	
Amaryllidaceae	
Allium cuthbertii Small	**H.S. 212 f. 36**, "Allium inodorum" D. Solander *in sched.*
Indet.	**H.S. 232 f. 61**
Commelinaceae	
Commelina erecta L.	**H.S. 212 f. 6**, *Commelina virginica* L. *det. in sched.* R. Howard, associated with *N.H.* 2-62. **H.S. 212 f. 57**, *Commelina virginica* L. *det. in sched.* *R.* Howard, associated with *N.H.* 2-62
Cyperaceae	
Carex sp.	**H.S. 232 f. 61**
Carex glaucescens Elliott	**H.S. 212 f. 44**, "Carex nutans" D. Solander *in sched.* **H.S. 232 f. 139**

Cyperus echinatus (L.) Wood	**H.S. 212 f. 86** **H.S. 232 f. 30**
Cyperus virens Michx.	**H.S. 232 f. 137**
Eleocharis sp.	**H.S. 232 f. 61**
Fuirena breviseta (Coville) Coville	**H.S. 212 f. 44**
Fuirena squarrosa Michx.	**H.S. 232 f. 139**
Rhynchospora colorata (L.) Pfeiffer	**H.S. 212 f. 45**, "Schoenus stellata" D. Solander *in sched.*
Rhynchospora fascicularis (Michx.) Vahl	**H.S. 232 f. 139**
Rhynchospora glomerata (L.) Vahl	**H.S. 212 f. 43**, *Schoenus glomeratus* L., *det. in sched.* D. Solander
Scirpus cyperinus (L.) Kunth	**H.S. 212 f. 87**
Dioscoreaceae	
Dioscorea villosa L.	**H.S. 212 f. 17**, "Dioscorea verticillata" D. Solander *in sched.*
Eriocaulaceae	
Eriocaulon decangulare L.	**H.S. 212 f. 41**, *Eriocaulon decangulare* L., *det. in sched.* D. Solander. **H.S. 212 f. 42**, *Eriocaulon decangulare* L., *det. in sched.* D. Solander. **H.S. 232 f. 133**
Haemodoraceae	
Lachnanthes caroliniana (Lam.) Dandy	**H.S. 232 f. 110**
Juncaceae	
Juncus scirpoides Lam.	**H.S. 212 f. 43**, "Juncus globulus" D. Solander *in sched.*
Liliaceae	
Lilium catesbaei Walt.	**H.S. 232 f. 68**, *Lilium catesbaei* Walter *det. in sched.* R. Howard, associated with *N.H.* 2-58
Medeola virginiana L.	**H.S. 232 f. 48**, *Medeola virginiana* L. *det. in sched.* D. Solander
Melanthiaceae	
Amianthium muscitoxicum (Walt.) A. Gray	**H.S. 212 f. 29**, "Veratrum longifolium" D. Solander *in sched.* **H.S. 212 f. 63**
Melanthium hybridum Walt.	**H.S. 212 f. 36**, "Veratrum viride" D. Solander *in sched.* **H.S. 232 f. 127**
Nartheciaceae	
Aletris aurea Walt.	**H.S. 232 f. 105**

Orchidaceae	
Habenaria repens Nutt.	**H.S. 212 f. 90**
Platanthera ciliaris (L.) Lindl.	**H.S. 212 f. 56**
Platanthera integra (Nutt.) A. Gray ex Beck	**H.S. 212 f. 55**
Poaceae	
Andropogon tenuispatheus (Nash) Nash	**H.S. 212 f. 87**
Cenchrus sp.	**H.S. 212 f. 84**
Chasmanthium latifolium (Michx.) Yates	**H.S. 232 f. 103**, *Uniola paniculata* L., *det. in sched.* D. Solander
Coelorachis rugosa (Nutt.) Nash	**H.S. 212 f. 85**
Ctenium aromaticum (Walt.) Wood	**H.S. 212 f. 44**
Echinochloa sp.	**H.S. 212 f. 44**
Eleusine indica (L.) Gaertn.	**H.S. 212 f. 85**
Indet.	**H.S. 212 f. 45**
Indet.	**H.S. 232 f. 61**
Leptochloa sp.	**H.S. 232 f. 103**
Paspalum floridanum Michx.	**H.S. 212 f. 83** **H.S. 232 f. 117**
Phalaris caroliniana Walt.	**H.S. 232 f. 61**
Saccharum giganteum (Walter) Pers.	**H.S. 212 f. 86**
Setaria magna Griseb.	**H.S. 212 f. 82**
Setaria parviflora (Poir.) Kerg.	**H.S. 212 f. 44** **H.S. 212 f. 83** **H.S. 232 f. 30**
Sporobolus indicus (L.) R. Br.	**H.S. 212 f. 85** **H.S. 212 f. 86**
Uniola paniculata L.	**H.S. 232 f. 56**, *Uniola paniculata* L., *det. in sched.* D. Solander
Zizania aquatica L.	**H.S. 212 f. 88**, *Zizania aquatica* L., *det. in sched.* D. Solander
Pontederiaceae	
Pontederia cordata L. var. *lancifolia* (Muhlenb. ex Elliott) Torr.	**H.S. 212 f. 19**, *Pontederia cordata* L., *det. in sched.* D. Solander
Pontederia cordata L. var. *cordata*	**H.S. 232 f. 67**, *Pontederia cordata* L., *det. in sched.* D. Solander

Ruscaceae	
Maianthemum racemosum (L.) Link	**H.S. 212 f. 60**, *Convallaria racemosa* L., *det. in sched.* D. Solander
Nolina georgiana Michx.	**H.S. 212 f. 32**, "Melanthium elatum" D. Solander *in sched.*
Polygonatum biflorum (Walt.) Elliott	**H.S. 212 f. 60**
Smilacaceae	
Smilax auriculata Walt.	**H.S. 232 f. 31**
Smilax pumila Walt.	**H.S. 212 f. 95**, "Smilax pubescens" D. Solander *in sched.*
Tofieldiaceae	
Triantha racemosa (Walt.) Small	**H.S. 232 f. 117**
Trilliaceae	
Trillium catesbaei Elliott	**H.S. 212 f. 59**, *Trillium catesbaei* Elliott *det. in sched.* R. Howard, associated with *N.H.* 1-45
Trillium maculatum Raf.	**H.S. 212 f. 59**, *Trillium maculatum* Raf. *det. in sched.* R. Howard, associated with *N.H.* 1-50
Xyridaceae	
Xyris ambigua Bey. ex Kunth	**H.S. 212 f. 42**, *Xyris indica* L., *det. in sched.* D. Solander
TRICOLPATES (EUDICOTS)	
Acanthaceae	
Dyschoriste oblongifolia (Michx.) Kuntze	**H.S. 232 f. 129**
Altingiaceae	
Liquidambar styraciflua L.	**H.S. 212 f. 79**, *Liquidambar styraciflua* L. *det. in sched.* R. Howard, associated with N.H. 2-65. **H.S. 232 f. 34**, *Liquidambar styraciflua* L. *det. in sched.* R. Howard, associated with N.H. 2-65
Anacardiaceae	
Toxicodendron radicans (L.) Kuntze	**H.S. 212 f. 19**
Toxicodendron vernix (L.) Kuntze	**H.S. 212 f. 25**, *Rhus vernix* L., *det. in sched.* D. Solander
Apiaceae	
Angelica venenosa (Greenway) Fern.	**H.S. 212 f. 39**, *Angelica lucida* L., *det. in sched.* D. Solander
Cicuta maculata L.	**H.S. 212 f. 27**
Eryngium integrifolium Walt.	**H.S. 212 f. 41**, *Eryngium foetidum* L., *det. in sched.* D. Solander

Osmorhiza longistylis (Torr.) D.C.	**H.S. 212 f. 32**, "Scandix suaveolens" D. Solander *in sched.* **H.S. 212 f. 34**, "Scandix suaveolens" D. Solander *in sched.*
Ptilimnium capillaceum (Michx.) Raf.	**H.S. 232 f. 116**
Thaspium barbinode (Michx.) Nutt.	**H.S. 212 f. 58a**
Thaspium trifoliatum (L.) A. Gray var. *trifoliatum*	**H.S. 212 f. 37**, *Thapsia trifoliata* L., *det. in sched.* D. Solander
Apocynaceae	
Amsonia tabernaemontana Walt. var. *tabernaemontana*	**H.S. 212 f. 37**, "Amsonia alternifolia" D. Solander *in sched.*
Apocynum cannabinum L.	**H.S. 212 f. 57**
Asclepias amplexicaulis Sm.	**H.S. 212 f. 30**, *Asclepias amoena* L., *det. in sched.* D. Solander
Asclepias humistrata Walt.	**H.S. 212 f. 30**, "Asclepias glabrata" D. Solander *in sched.* **H.S. 232 f. 86**
Asclepias obovata Elliott	**H.S. 232 f. 114**
Asclepias perennis Walt.	**H.S. 232 f. 122**, *Asclepias nivea* L., *det. in sched.* D. Solander, *A. perennis* by A.M. Vail
Asclepias rubra L.	**H.S. 232 f. 83**, "Asclepias floridana" D. Solander *in sched.*
Asclepias tuberosa L.	**H.S. 212 f. 30**, "Asclepias hirta" D. Solander *in sched.* **H.S. 212 f. 31**, *Asclepias tuberosa* L. *det. in sched.* A. Vail
Asclepias verticillata L.	**H.S. 212 f. 30**, *Asclepias verticillata* L., *det. in sched.* D. Solander
Asclepias viridiflora Raf.	**H.S. 212 f. 18**, *Asclepias nivea* L., *det. in sched.* D. Solander
Matelea carolinensis (Jacq.) Woods.	**H.S. 212 f. 17**, *Cynanchum hirsutum* L., *det. in sched.* D. Solander
Aquifoliaceae	
Ilex ambigua (Michx.) Torr.	**H.S. 212 f. 15**, "Andromeda axillaris" D. Solander *in sched.*
Ilex cassine L.	**H.S. 212 f. 65**, *Ilex cassine* L. *det. in sched.*
Ilex cassine x *opaca*	**H.S. 212 f. 65**, *Ilex cassine* L. *det. in sched.* Schultes and Alston
Asteraceae	
Ampelaster carolinianus (Walt.) Nesom	**H.S. 212 f. 83** **H.S. 232 f. 41**

Arnoglossum atriplicifolium (L.) H. Rob.	**H.S. 212 f. 6**
Berlandiera pumila (Michx.) Nutt.	**H.S. 212 f. 34**, "Colymmia cordifolia" D. Solander *in sched.*
Bidens frondosa L.	**H.S. 212 f. 8**, *Bidens frondosa* L., *det. in sched.* D. Solander
Bidens sp.	**H.S. 212 f. 7**
Bigelowia nudata (Michx.) DC.	**H.S. 212 f. 74**, "Chrysocoma linifolia" D. Solander *in sched.*
Carphephorus carnosus (Small) C.W. James	**H.S. 232 f. 30**, "Nelia eriocephala" D. Solander *in sched.*
Chaptalia tomentosa Vent.	**H.S. 212 f. 35**, "Tusilago integrifolia" D. Solander *in sched.*
Chrysogonum virginianum L.	**H.S. 212 f. 17**
Chrysopsis gossypina (Michx.) Elliott	**H.S. 232 f. 42**
Chrysopsis mariana (L.) Elliott	**H.S. 212 f. 96** **H.S. 232 f. 42** **H.S. 232 f. 64**
Coreopsis delphiniifolia Lam.	**H.S. 232 f. 29**
Coreopsis lanceolata L.	**H.S. 212 f. 20**, *Coreopsis lanceolata* L., *det. in sched.* D. Solander. **H.S. 232 f. 123**
Coreopsis major Walt. var. *major*	**H.S. 212 f. 33**, "Coreopsis stellata" D. Solander *in sched.* **H.S. 232 f. 48**
Erigeron quercifolius Lam.	**H.S. 212 f. 40**, *Erigeron jamaicense* L., *det. in sched.* D. Solander
Erigeron strigosus Muhlenb. ex Willd.	**H.S. 232 f. 127**
Eupatorium sp.	**H.S. 212 f. 88**
Eupatorium capillifolium (Lam.) Small	**H.S. 212 f. 84** **H.S. 232 f. 49**
Eupatorium compositifolium Walt.	**H.S. 212 f. 89**
Eupatorium leucolepis (DC.) Torr. & A. Gray	**H.S. 212 f. 10**
Eupatorium perfoliatum L.	**H.S. 212 f. 74**
Eupatorium purpureum L. var. *purpureum*	**H.S. 232 f. 28**
Eupatorium serotinum Michx.	**H.S. 212 f. 89** **H.S. 232 f. 73**
Euthamia caroliniana (L.) Greene ex Porter & Britton	**H.S. 212 f. 9**, *Chrysocoma graminifolia* L., *det. in sched.* D. Solander **H.S. 232 f. 40**

Eutrochium dubium (Willd. ex Poir.) E.E. Lamont	**H.S. 212 f. 49**
Gaillardia aestivalis (Walt.) H. Rock var. *aestivalis*	**H.S. 212 f. 40**, "Ageratum uniflorum" D. Solander *in sched.* **H.S. 232 f. 123**
Gamochaeta antillana (Urb.) Anderb.	**H.S. 212 f. 35**, "Gnaphalium hirtum" D. Solander *in sched.*
Helenium flexuosum Raf.	**H.S. 212 f. 33**, "Fostera suaveolens" D. Solander *in sched.* **H.S. 232 f. 29**
Helianthus angustifolius L.	**H.S. 212 f. 92**
Helianthus hirsutus Raf.	**H.S. 232 f. 114**
Heliopsis helianthoides (L.) Sweet var. *helianthoides*	**H.S. 232 f. 113**
Indet.	**H.S. 212 f. 41**
Lactuca sp.	**H.S. 232 f. 61**, *Erysima offic.* in pen.
Liatris elegans (Walter) Michx.	**H.S. 212 f. 92**, "Serratula speciosa" D. Solander *in sched.* **H.S. 212 f. 94**, "Serratula speciosa" D. Solander *in sched.* **H.S. 232 f. 40**, "Serratula speciosa" D. Solander *in sched.*
Liatris secunda Elliott	**H.S. 232 f. 111**, "Serratula secunda" D. Solander *in sched.*
Liatris spicata (L.) Willd. var. *resinosa* (Nutt.) Gaiser	**H.S. 212 f. 94**, *Serratula spicata* L., *det. in sched.* D. Solander **H.S. 232 f. 111**
Liatris squarrosa (L.) Michx. var. *squarrosa*	**H.S. 212 f. 54**, *Serratula squarrosa* L., *det. in sched.* D. Solander
Liatris squarrulosa Michx.	**H.S. 212 f. 96** **H.S. 232 f. 42**, *Serratula scariosa* L., *det. in sched.* D. Solander
Marshallia graminifolia (Walt.) Small	**H.S. 212 f. 53**, *Serratula scariosa* L., *det. in sched.* D. Solander
Marshallia obovata (Walter) Beadle & Boynt. var. *scaposa* Channell	**H.S. 212 f. 60**
Pityopsis graminifolia (Michx.) Nutt. var. *latifolia* (Fern.) Semple & Bowers	**H.S. 212 f. 72**
Pluchea foetida (L.) DC.	**H.S. 212 f. 51**
Prenanthes autumnalis Walt.	**H.S. 212 f. 83**
Prenanthes serpentaria Pursh	**H.S. 232 f. 134**
Pseudognaphalium obtusifolium (L.) Hilliard & Burtt	**H.S. 212 f. 75**

Rudbeckia hirta L.	**H.S. 232 f. 49**
Sericocarpus asteroides (L.) B.S.P.	**H.S. 212 f. 35**
Sericocarpus tortifolius (Michx.) Nees	**H.S. 212 f. 94**
Silphium asteriscus L.	**H.S. 212 f. 18**, *Silphium asteriscus* L., *det. in sched.* D. Solander
Smallanthus uvedalius (L.) Mack. ex Small	**H.S. 232 f. 102**
Solidago fistulosa Mill.	**H.S. 212 f. 10**
Solidago odora Ait.	**H.S. 212 f. 9**, *Solidago sempervirens* L., *det. in sched.* D. Solander
Solidago petiolaris Ait. var. *petiolaris*	**H.S. 232 f. 63**
Solidago sempervirens L.	**H.S. 212 f. 75**
Symphyotrichum concolor (L.) Nesom	**H.S. 212 f. 96**
Symphyotrichum concolor (L.) Nesom var. *concolor*	**H.S. 232 f. 64**
Symphyotrichum dumosum (L.) Nesom	**H.S. 212 f. 71** **H.S. 232 f. 123**
Trilisa paniculata (J.F. Gmel.) Cass.	**H.S. 212 f. 96**, "Serratula paniculata" D. Solander *in sched.* **H.S. 232 f. 40** "Serratula paniculata" D. Solander *in sched.*
Vernonia acaulis (Walter) Gleason	**H.S. 232 f. 130**
Vernonia angustifolia Michx.	**H.S. 212 f. 62**
Vernonia gigantea (Walter) Trelease	**H.S. 232 f. 66**
Balsaminaceae	
Impatiens capensis Meerburgh	**H.S. 232 f. 74**, "Impatiens americana" D. Solander *in sched.* **H.S. 232 f. 115**
Berberidaceae	
Podophyllum peltatum L.	**H.S. 212 f. 63**, *Podophyllum peltatum* L., *det. in sched.* D. Solander; *Podophyllum peltatum* L. *det. in sched.* R. Howard, associated with *N.H.* 1-24
Betulaceae	
Carpinus caroliniana Walt.	**H.S. 212 f. 13**, *Carpinus ostrya* L., *det. in sched.* D. Solander
Ostrya virgiana (Mill.) K. Koch	**H.S. 232 f. 61**

Bignoniaceae	
Catalpa bignonioides Walt.	**H.S. 212 f. 61**, *Catalpa bignonioides* Walt. *det. in sched.* R. Howard, associated with *N.H.* 1-49; *Catalpa bignonioides* Walt. *det. in sched.* J. Reveal, provisionally selected *in sched.* as voucher for syntype of *Bignonia catalpa* L. by J. Reveal for Linnaean Plant Name Typification Project. **H.S. 232 f. 51**, *Catalpa bignonioides* Walt. *det. in sched. R.* Howard, associated with *N.H.* 1-49; *Catalpa bignonioides* Walt. *det. in sched.* J. Reveal, provisionally selected *in sched.* as voucher for syntype of *Bignonia catalpa* L. by J. Reveal for Linnaean Plant Name Typification Project
Boraginaceae	
Lithospermum caroliniense (Walt. ex J.F. Gmel.) MacMill.	**H.S. 212 f. 54**
Onosmodium virginianum (L.) DC.	**H.S. 212 f. 40**, "Lithospermum nervosum" D. Solander *in sched.*
Brassicaceae	
Nasturtium officinale R. Br.	**H.S. 232 f. 61**
Campanulaceae	
Lobelia elongata Small	**H.S. 212 f. 7** **H.S. 232 f. 48**, "Lobelia pedicularis" D. Solander *in sched.*
Lobelia puberula Michx.	**H.S. 212 f. 7**, "Lobelia laevigata" D. Solander *in sched.*
Triodanis perfoliata (L.) Nieuwl.	**H.S. 212 f. 31**, *Campanula perfoliata* L., *det. in sched.* D. Solander
Caryophyllaceae	
Indet.	**H.S. 232 f. 61**
Silene virginica L.	**H.S. 212 f. 18**, *Silene virginica* L., *det. in sched.* D. Solander; *Silene virginica* L. det. in sched. R. Howard, associated with *N.H.* 2-54
Clethraceae	
Clethra tomentosa Lam.	**H.S. 212 f. 50**, *Clethra alnifolia* L. *det. in sched.* R. Howard, associated with *N.H.* 1-66. **H.S. 232 f. 35**, *Clethra alnifolia* L. *det. in sched.* R. Howard, associated with *N.H.* 1-66
Convolvulaceae	
Calystegia catesbeiana Pursh	**H.S. 212 f. 34**, *Convolvulus hederaceus* L., *det. in sched.* D. Solander
Ipomoea coccinea L.	**H.S. 232 f. 61**
Ipomoea sp.	**H.S. 232 f. 61**

Cornaceae	
Cornus asperifolia Michx.	**H.S. 232 f. 60**
Cornus florida L.	**H.S. 212 f. 5**, *Cornus florida* L. *det. in sched.* R. Howard, associated with *N.H.* 1-27. **H.S. 232 f. 89**, *Cornus florida* L. *det. in sched.* R. Howard, associated with *N.H.* 1-27
Cucurbitaceae	
Melothria pendula L.	**H.S. 232 f. 135**
Cyrillaceae	
Cyrilla racemiflora L.	**H.S. 212 f. 67**, *Friegia[?] lavigata* by Solander *in sched.* **H.S. 232 f. 55**
Ebenaceae	
Diospyros virginiana L.	**H.S. 212 f. 2** **H.S. 232 f. 47**
Ericaceae	
Ceratiola ericoides Michx.	**H.S. 232 f. 31**
Kalmia latifolia L.	**H.S. 212 f. 64**, *Kalmia latifolia* L. *det. in sched.* R. Howard, associated with *N.H.* 2-98. **H.S. 232 f. 54**, *Kalmia latifolia* L. *det. in sched.* R. Howard, associated with *N.H.* 2-98
Leucothoe fontanesiana (Steud.) Sleumer	**H.S. 212 f. 15**
Lyonia lucida (Lam.) K. Koch	**H.S. 212 f. 65**
Oxydendrum arboreum (L.) DC.	**H.S. 212 f. 66**, *Andromeda arborea* L., *det. in sched.* D. Solander; *Oxydendrum arboreum* (L.) DC *det. in sched.* R. Howard, associated with *N.H.* 1-71; *Oxydendrum arboretum* (L.) DC. *det. in sched.* J. Reveal, provisionally accepted *in sched.* by J. Reveal as typotype of syntype of *Andromeda arborea* L. for Linnaean Plant Name Typification Project. **H.S. 232-57**, *Oxydendrum arboreum* (L.) DC *det. in sched.* R. Howard, associated with *N.H.* 1-71; *Oxydendrum arboretum* (L.) DC. *det. in sched.* J. Reveal, provisionally accepted *in sched.* by J. Reveal as typotype of syntype of *Andromeda arborea* L. for Linnaean Plant Name Typification Project
Vaccinium stamineum L. var. *caesium* (Greene) D.B. Ward	**H.S. 212 f. 60**, "Vaccinium clavatum" D. Solander *in sched.*

Euphorbiaceae	
Euphorbia sp.	**H.S. 212 f. 47** **H.S. 212 f. 48** **H.S. 212 f. 51**
Cnidoscolus stimulosus (Michx.) Engelm. & A. Gray	**H.S. 212 f. 32**, *Jatropha urens* L., *det. in sched.* D. Solander
Stillingia sylvatica Garden ex L. ssp. *sylvatica*	**H.S. 212 f. 53**, "Aniba ovata" D. Solander *in sched.* **H.S. 232 f. 65**, "Aniba ovata" D. Solander *in sched.*
Tragia urticifolia Michx.	**H.S. 212 f. 55**
Fabaceae	
Amorpha glabra Desf. ex Poir.	**H.S. 212 f. 64**
Amorpha herbacea Walt.	**H.S. 212 f. 65**
Apios americana Medik.	**H.S. 232 f. 138**
Astragalus michauxii (Kuntze) F.J. Herm.	**H.S. 212 f. 58b** **H.S. 212 f. 62**
Baptisia albescens Small	**H.S. 212 f. 53** **H.S. 212 f. 54**
Baptisia bracteata Elliott	**H.S. 212 f. 20**, "Sophora cerulea" D. Solander *in sched.*
Baptisia perfoliata (L.) R. Br.	**H.S. 212 f. 58b**, "Sophora perfoliata" D. Solander *in sched.* **H.S. 232 f. 72**, "Sophora perfoliata" D. Solander *in sched.*
Baptisia tinctoria (L.) Vent.	**H.S. 212 f. 28**, *Sophora tinctoria* L., *det. in sched.* D. Solander. **H.S. 232 f. 108**
Cercis canadensis L.	**H.S. 212 f. 2**, *Cercis canadensis* L., *det. in sched.* D. Solander
Chamaecrista nictitans (Michx.) Greene	**H.S. 232 f. 46**
Dalea pinnata (J.F. Gmel.) Barneby	**H.S. 212 f. 90**, "Nelia monocephala" D. Solander *in sched.*
Galactia regularis (L.) B.S.P.	**H.S. 232 f. 112**
Galactia volubilis (L.) Britt.	**H.S. 212 f. 91**, *Hedyglarum volubile* L., *det. in sched.* D. Solander
Gleditsia aquatica Marsh.	**H.S. 212 f. 61**
Hylodesmum glutinosum (Muhlenb. ex Willd.) H. Ohashi & R.R. Mill	**H.S. 212 f. 38** **H.S. 232 f. 70**
Indigofera tinctoria L.	**H.S. 232 f. 106**, *Indigofera tinctoria* L. *det. in sched.*
Lespedeza hirta (L.) Hornem. var. *curtissii* (Clewell) Isely	**H.S. 232 f. 44** **H.S. 232 f. 63**
Lespedeza virginica (L.) Britt.	**H.S. 212 f. 93**

Lupinus diffusus Nutt.	**H.S. 212 f. 57**
Lupinus villosus Willd.	**H.S. 212 f. 57**
Mimosa quadrivalvis L.	**H.S. 232 f. 107**
Orbexilum pedunculatum (Mill.) Rydb. var. *psoralioides* (Walt.) Isely	**H.S. 212 f. 23**, "Hedysarum spicatum" D. Solander *in sched.* **H.S. 232 f. 119** **H.S. 232 f. 121**
Pediomelum canescens (Michx.) Rydb.	**H.S. 212 f. 41** **H.S. 232 f. 38**
Phaseolus polystachios (L.) B.S.P.	**H.S. 212 f. 39**
Rhynchosia tomentosa (L.) Hook. & Arn.	**H.S. 232 f. 83**
Senna occidentalis (L.) Link	**H.S. 212 f. 1** **H.S. 212 f. 81**, *Cassia occidentalis* L., *det. in sched.* D. Solander
Stylosanthes biflora (L.) B.S.P.	**H.S. 232 f. 119**
Tephrosia spicata (Walt.) Torr. & A. Gray	**H.S. 232 f. 28.** **H.S. 232 f. 119**
Tephrosia virginiana (L.) Pers.	**H.S. 212 f. 56**, *Galega virginiana* L., *det. in sched.* D. Solander
Fagaceae	
Castanea pumila (L.) Mill.	**H.S. 232 f. 36**, *Castanea pumila* L. *det. in sched.* R. Howard, associated with *N.H.* 1-9
Quercus alba L.	**H.S. 232 f. 91**, *Quercus alba* L. *det. in sched.* R. Howard, associated with *N.H.* 1-21
Quercus incana Bartr.	**H.S. 212 f. 78**, *Quercus incana* Bartram *det. in sched.* R. Howard, associated with *N.H.* 1-22
Quercus laevis Walt.	**H.S. 212 f. 78**, *Quercus rubra* L., *det. in sched.* D. Solander; *Quercus laevis* Walter *det. in sched.* R. Howard, associated with *N.H.* 1-23**.** **H.S. 232 f. 88**, *Quercus rubra* L., *det. in sched.* D. Solander; *Quercus laevis* Walter *det. in sched.* R. Howard, associated with *N.H.* 1-23
Quercus marilandica Muenchh.	**H.S. 232 f. 93**, *Quercus marilandica* Muenchh. *det. in sched.* R. Howard, associated with *N.H.* 1-19
Quercus michauxii Nutt.	**H.S. 212 f. 5**, *Quercus prinus* L., *det. in sched.* D. Solander; *Quercus prinus* L. *det. in sched.* R. Howard, associated with *N.H.* 1-18. **H.S. 232 f. 14**, *Quercus prinus* L., *det. in sched.* D. Solander; *Quercus prinus* L. *det. in sched.* R. Howard, associated with *N.H.* 1-18
Quercus nigra L.	**H.S. 232 f. 96**, *Quercus nigra* L. *det. in sched.* R. Howard, associated with *N.H.* 1-20

Quercus phellos L.	**H.S. 212 f. 77**, *Quercus phellos* L. *det. in sched.* R. Howard, associated with *N.H.* 1-16. **H.S. 232 f. 98**, *Quercus phellos* L. *det. in sched.* R. Howard, associated with *N.H.* 1-16
Quercus virginiana Mill.	**H.S. 212 f. 81**, *Quercus virginiana* Mill. *det. in sched.* R. Howard, associated with *N.H.* 1-17
Gentianaceae	
Gentiana catesbaei Walt.	**H.S. 212 f. 87**, *Gentiana catesbaei* Walt. *det. in sched.* R. Howard, associated with *N.H.* 1-70
Sabatia angularis (L.) Pursh	**H.S. 212 f. 7**, *Chironia angularis* L., *det. in sched.* D. Solander
Sabatia difformis (L.) Druce	**H.S. 232 f. 105**
Sabatia stellaris Pursh	**H.S. 232 f. 128**
Hamamelidaceae	
Hamamelis virginiana L.	**H.S. 212 f. 4**, *Hamamelis virginiana* L., *det. in sched.* D. Solander; *Hamamelis virginiana* L. *det. in sched.* R. Howard, associated with *N.H.* 2 app. 2
Hydrangeaceae	
Hydrangea arborescens L.	**H.S. 212 f. 55**
Hydrangea radiata Walt.	**H.S. 232 f. 55**
Philadelphus inodorus L.	**H.S. 212 f. 16**, *Philadelphus inodorus* L., *det. in sched.* D. Solander, *Philadelphus inodorus* L. *det. in sched.* R. Howard, associated with *N.H.* 2-84
Hypericaceae	
Hypericum crux-andreae (L.) Crantz	**H.S. 212 f. 50**, *Ascyrum crux andrea* L., *det. in sched.* D. Solander
Hypericum walteri J.G. Gmel.	**H.S. 232 f. 76**
Iteaceae	
Itea virginica L.	**H.S. 212 f. 15**, *Itea virginica* L., *det. in sched.* D. Solander **H.S. 232 f. 80**
Juglandaceae	
Carya tomentosa (Lam. ex Poir.) Nutt.	**H.S. 212 f. 3**, *Juglans alba* L., *det. in sched.* D. Solander; *Carya tomentosa* (Poir.) Nutt. *det. in sched.* R. Howard, associated with *N.H.* 1-38. **H.S. 232 f. 94**, *Juglans nigra* L. *det. in sched.* R. Howard, associated with *N.H.* 1-67. **H.S. 232 f. 97**, *Juglans nigra* L. *det. in sched.* R. Howard, associated with *N.H.* 1-67

Lamiaceae	
Collinsonia canadensis L.	**H.S. 232 f. 75**
Collinsonia tuberosa Michx.	**H.S. 212 f. 8**, *Collinsonia canadensis* L., *det. in sched.* D. Solander
Hyptis alata (Raf.) Shinners	**H.S. 212 f. 43**
Indet.	**H.S. 212 f. 76**
Indet.	**H.S. 232 f. 131**
Lycopus virginicus L.	**H.S. 212 f. 9**, *Lycopus virginicus* L., *det. in sched.* D. Solander
Monarda punctata L.	**H.S. 212 f. 6**, *Monarda punctata* L., *det. in sched.* D. Solander **H.S. 212 f. 48**, *Monarda punctata* L., *det. in sched.* D. Solander **H.S. 232 f. 103**
Physostegia purpurea (Walt.) Blake	**H.S. 232 f. 121**
Prunella vulgaris L. var. *lanceolata* (W. Bart.) Fern.	**H.S. 212 f. 63**
Pycnanthemum flexuosum (Walt.) B.S.P.	**H.S. 212 f. 55** **H.S. 212 f. 75** **H.S. 232 f. 137**
Pycnanthemum pycnanthemoides (Leavenw.) Fern. var. *pycnanthemoides*	**H.S. 212 f. 26,** *Clinopodium incanum* L., *det. in sched.* D. Solander
Salvia lyrata L.	**H.S. 212 f. 22**, *Salvia lyrata* L., *det. in sched.* D. Solander **H.S. 212 f. 62**
Scutellaria elliptica Muhl. ex Spreng.	**H.S. 212 f. 27**, *Scutellaria laterifolia* L., *det. in sched.* D. Solander
Stachys indet., most likely *Stachys nuttallii* Shuttlew. ex Benth.	**H.S. 212 f. 29**, "Stachys intermedia" D. Solander *in sched.*
Teucrium canadense L.	**H.S. 232 f. 37**, "Teucrium spiciferum" D. Solander *in sched.*
Trichostema dichotomum L.	**H.S. 212 f. 74**
Loganiaceae	
Spigelia marilandica (L.) L.	**H.S. 212 f. 33**, *Spigelia marilandica* (L.) L. *det. in sched.* R. Howard, associated with *N.H.* 2-78
Malvaceae	
Hibiscus moscheutos L.	**H.S. 232 f.109**
Kosteletzkya pentacarpos (L.) Ledeb.	**H.S. 212 f. 92**

Sida rhombifolia L.	**H.S. 212 f. 50**, *Sida rhombifolia* L., *det. in sched.* D. Solander **H.S. 212 f. 51**, *Sida rhombifolia* L., *det. in sched.* D. Solander
Tilia americana L. var. *heterophylla* (Vent.) Loud.	**H.S. 212 f. 69**
Melastomataceae	
Rhexia alifanus Walt.	**H.S. 212 f. 43**, "Rhexia glabrata" D. Solander *in sched* **H.S. 232 f. 110**, "Rhexia glabrata" D. Solander *in sched.*
Rhexia virginica L.	**H.S. 232 f. 134**
Menispermaceae	
Cocculus carolinus (L.) DC.	**H.S. 212 f. 95** **H.S. 232 f. 41**, *Cocculus carolinus* (L.) DC. *det. in sched.* R. Howard, associated with *N.H.* 1-51 **H.S. 232 f. 104**, *Cocculus carolinus* (L.) DC. *det. in sched.* R. Howard, associated with *N.H.* 1-51
Menispermum canadense L.	**H.S. 212 f. 21**, *Menispermum canadense* L., *det. in sched.* D. Solander
Moraceae	
Morus rubra L.	**H.S. 232 f. 92**
Nyssaceae	
Nyssa aquatica L.	**H.S. 212 f. 67**, *Nyssa aquatica* L. *det. in sched.* R. Howard, associated with *N.H.* 1-60. **H.S. 232 f. 52**, *Nyssa aquatica* L. *det. in sched.* R. Howard, associated with *N.H.* 1-60 and with typotype
Nyssa sp.	**H.S. 212 f. 3**
Nyssa sylvatica L.	**H.S. 212 f. 77**, *Nyssa sylvatica* Marsh. *det. in sched.* R. Howard, associated with *N.H.* 1-41
Oleaceae	
Fraxinus pennsylvanica Marsh.	**H.S. 212 f. 11**, *Fraxinus americana* L. *det. in sched.* R. Howard, associated with *N.H.* 1-80
Osmanthus americanus (L.) Benth. & Hook. f. ex A. Gray	**H.S. 212 f. 22**, *Osmanthus americanus* (L.) Gray *det. in sched.* R. Howard, associated with *N.H.* 1-61
Onagraceae	
Ludwigia pilosa Walt.	**H.S. 212 f. 47**, "Ludwigia villosa" D. Solander *in sched.* **H.S. 212 f. 52**, "Ludwigia villosa" D. Solander *in sched.*

Ludwigia virgata Michx.	**H.S. 212 f. 52**, *Ludwigia alternifolia* L., *det. in sched.* D. Solander
Oenothera filipes (Spach) Wagner & Hoch	**H.S. 232 f. 44** **H.S. 232 f. 115**
Orobanchaceae	
Agalinis purpurea (L.) Penn.	**H.S. 212 f. 73**
Epifagus virginiana (L.) W. Barton	**H.S. 232 f. 99**
Pedicularis canadensis L.	**H.S. 212 f. 19**, "Pedicularis umbellifera" D. Solander *in sched.* **H.S. 212 f. 19**, "Pedicularis dissilimis" D. Solander *in sched.* **H.S. 232 f. 78**
Seymeria cassioides (J.F. Gmel.) S.F. Blake	**H.S. 212 f. 72** **H.S. 212 f. 73**
Seymeria pectinata Pursh	**H.S. 232 f. 126**
Plantaginaceae	
Bacopa monnieri (L.) Penn.	**H.S. 212 f. 47**
Platanaceae	
Platanus occidentalis L.	**H.S. 212 f. 68**, *Platanus occidentalis* L., *det. in sched.* D. Solander; *Plantanus occidentalis* L. *det. in sched.* R. Howard, associated with *N.H.* 1-56
Podostemaceae	
Podostemum ceratophyllum Michx.	**H.S. 212 f. 41**
Polemoniaceae	
Phlox amoena Sims	**H.S. 212 f. 62**
Ipomopsis rubra (L.) Wherry	**H.S. 232 f. 131**
Polygalaceae	
Polygala cruciata L.	**H.S. 212 f. 21**, *Polygala cruciata* L., *det. in sched.* D. Solander
Polygala grandiflora Walt.	**H.S. 232 f. 30**
Polygala lutea L.	**H.S. 212 f. 49** **H.S. 212 f. 59** **H.S. 232 f. 118**
Polygala mariana Mill.	**H.S. 232 f. 124**
Polygala polygama Walt.	**H.S. 212 f. 31**, "Polygala foliosa" D. Solander *in sched.* **H.S. 232 f. 68**
Polygala ramosa Elliott	**H.S. 212 f. 58b**, *Polygala paniculata* L., *det. in sched.* D. Solander

Polygonaceae	
Brunnichia ovata (Walt.) Shinners	**H.S. 232 f. 101**, "Brunnickia cirrhosa" D. Solander *in sched.*
Eriogonum tomentosum Michx.	**H.S. 232 f. 43**, *Eriogonum tomentosum* Michx. by Reveal
Persicaria virginiana (L.) Gaertn.	**H.S. 232 f. 39**
Primulaceae	
Lysimachia ciliata L.	**H.S. 212 f. 37**, *Lysimachia ciliata* L., *det. in sched.* D. Solander
Lysimachia fraseri Duby	**H.S. 212 f. 36**, "Lysimachia stellata" D. Solander *in sched.*
Lysimachia quadrifolia L.	**H.S. 212 f. 18**, *Lysimachia quadrifolia* L., *det. in sched.* D. Solander
Ranunculaceae	
Actaea racemosa L.	**H.S. 232 f. 61**
Clematis crispa L.	**H.S. 232 f. 122**
Clematis viorna L.	**H.S. 212 f. 63**
Delphinium carolinianum Walt.	**H.S. 212 f. 59**
Thalictrum revolutum DC	**H.S. 212 f. 29**, *Thalictrum cornutis* L., *det. in sched.* D. Solander
Trautvetteria caroliniensis (Walt.) Vail	**H.S. 212 f. 56**
Rhamnaceae	
Berchemia scandens (Hill) K. Koch	**H.S. 232 f. 61**
Ceanothus americanus L.	**H.S. 212 f. 35**, *Ceanothus americanus* L., *det. in sched.* D. Solander. **H.S. 212 f. 76** **H.S. 232 f. 68**
Rosaceae	
Geum canadense Jacq.	**H.S. 212 f. 56** **H.S. 232 f. 125**
Prunus caroliniana Ait.	**H.S. 212 f. 12**
Prunus umbellata Elliott	**H.S. 212 f. 15**, "Prunus villosus" D. Solander *in sched.*
Rubus pensilvanicus Poir.	**H.S. 212 f. 23**, "Rubus viminalis" D. Solander *in sched.*
Rubiaceae	
Cephalanthus occidentalis L.	**H.S. 232 f. 59**

Rutaceae	
Ptelea trifoliata L.	**H.S. 212 f. 66**, *Ptelea trifoliata* L. *det. in sched.* R. Howard, associated with *N.H.* 2-83. **H.S. 232 f. 53**, *Ptelea trifoliata* L. *det. in sched.* R. Howard, associated with *N.H.* 2-83. **H.S. 232 f. 86**
Salicaceae	
Populus deltoides Bartr. ex Marsh.	**H.S. 212** f. 11, *Populus balsamifera* L., *det. in sched.* D. Solander, *Populus det. in sched.* R. Howard, with this note: "Rouleau (Rhodora 48:103-110) concluded Catesby 1-34 was *P. heterophylla* but the description a mixture of *P. heterophylla* and *P. deltoides.*"
Populus heterophylla L.	**H.S. 232 f. 52**
Sapindaceae	
Acer negundo L.	**H.S. 212 f. 12**, *Acer negundo* L., *det. in sched.* D. Solander
Acer rubrum L. var. *rubrum*	**H.S. 232 f. 32**, *Acer rubrum* L. *det. in sched.* R. Howard, associated with *N.H.* 1-62
Acer saccharinum L.	**H.S. 212 f. 14**, *Acer rubrum* L., *det. in sched.* D. Solander, *Acer rubrum* L. *det. in sched.* R. Howard, associated with *N.H.* 1-62
Sarraceniaceae	
Sarracenia minor Walt.	**H.S. 212 f. 21**, *Sarracenia flava* L., *det. in sched.* D. Solander; *S. minor* Walt. or *S. variolaris* Michx. *det. in sched.* J.M. Macfarlane (1906); *Sarracenia x catesbaei* (Elliot) Bell? *det. in sched.* R. Howard, associated with *N.H.* 2-69. **H.S. 212 f. 45**, *Sarracenia flava* L., *det. in sched.* D. Solander. **H.S. 212 f. 47**
Sarracenia rubra Walt.	**H.S. 212 f. 20**, *Sarracenia x catesbaei* (Elliot) Bell? *det. in sched.* R. Howard, associated with *N.H.* 2-69
Solanaceae	
Physalis angulata L.	**H.S. 212 f. 46**, *Physalis angulata* L., *det. in sched.* D. Solander
Styracaceae	
Styrax americanus Lam.	**H.S. 212 f. 16**, "Borlacea tenera" D. Solander *in sched.*
Tetrachondraceae	
Polypremum procumbens L.	**H.S. 232 f. 136**, *Polypremum procumbens* L., *det. in sched.* D. Solander

Theaceae	
Gordonia lasianthus (L.) Ellis	**H.S. 212 f. 13**, *Hypericum lasianthus* L., *det. in sched.* D. Solander, *Gordonia lasianthus* (L.) Ellis *det. in sched.* R. Howard, associated with *N.H.* 1-44; *Gordonia lasianthus* (L.) Ellis *det. in sched.* J. Reveal; provisionally accepted as lectotype for *Hypericum lasianthus* L. for Linnaean Plant Name Typification Project. **H.S. 232 f. 50**, *Gordonia lasianthus* (L.) Ellis *det. in sched.* R. Howard, associated with *N.H.* 1-44; *Gordonia lasianthus* (L.) Ellis *det. in sched.* J. Reveal; provisionally accepted as lectotype for *Hypericum lasianthus* L. for Linnaean Plant Name Typification Project
Ulmaceae	
Ulmus rubra Muhlenb.	**H.S. 212 f. 70**
Urticaceae	
Laportea canadensis (L.) Wedd.	**H.S. 232 f. 71**
Verbenaceae	
Glandularia canadensis (L.) Nutt	**H.S. 212 f. 22**, "Aitonia buchneroides" D. Solander *in sched.* **H.S. 212 f. 58a**
Phyla nodiflora (L.) Greene	**H.S. 212 f. 93**
Violaceae	
Viola lanceolata L. var. *vittata* (Greene) Weatherby & Griscom	**H.S. 212 f. 34**, "Viola angustifolia" D. Solander *in sched.*
Viola sororia Willd.	**H.S. 212 f. 59**
Vitaceae	
Ampelopsis arborea (L.) Koehne	**H.S. 232 f. 59**
Vitis aestivalis Michx.	**H.S. 232 f. 87**

Discussion

What is the use of herbarium specimens? What can we possibly learn from pieces of plants pressed and dried nearly 300 years ago? We have in fact learned a great deal. In this section we describe a few of our insights, into nomenclature, geography, ecology, economic botany, and history. Doubtless many other treasures are yet to be found. We hope this discussion illustrates just how valuable these historic collections are.

Importance to nomenclature

Though none of the specimens contained within the Catesby collections at the Sloane Herbarium may be considered lectotypes, their examination can yield insight into the color plates of the *Natural History*, which can clarify issues of typification. Reveal provisionally identified several

specimens[5] as types as part of the Linnaean Plant Name Typification Project in 1989. Howard and Staples (1983) and Dandy (1958) have noted the type status of other specimens. We have found that there is still work to be done utilizing these *Horti Sicci* to better understand what is represented in the *Natural History*.

For example, examination of Catesby's collections of *Clethra* and comparison of them with *Natural History* plate 1-66 raises the possibility that the current type specimen of *Clethra alnifolia* L. (Sleumer 1967) does not agree with current usage and that all type collections may be *Clethra tomentosa* Lam.

Howard and other previous scholars have associated plate 1-66 with two specimens collected by Catesby, H.S. 212 f. 50 and H.S. 232 f. 35. We have identified these specimens as *Clethra tomentosa* Lam. It is possible that Catesby's color plate came from live material observed in Virginia or from material that was gathered in the Charleston area, which is within the range of both *C. alnifolia* and *C. tomentosa*. The plate from the *Natural History* does not conform to any specimen in the Sloane Herbarium Catesby collections.

Weakley distinguishes *Clethra alnifolia* from *C. tomentosa*. According to his key, *C. alnifolia* has "Lower leaf surface sparsely hairy; petioles 2.5-3.5 (-6) cm long; styles 6-7 mm long, hairy at the base with straight hairs; filaments 0.2-0.3 (-0.4) mm in diameter." *Clethra tomentosa* is described as "Lower leaf surface wooly-tomentose; petioles 0.5-1 (-1.5) cm long; styles 3.5-5 mm long, downy throughout; filaments 0.4-0.5 (-0.7) mm in diameter." Catesby collected two specimens of *Clethra*, H.S. 212 f. 50 and H.S. 232 f. 35. Howard identified both as *Clethra alnifolia* L. and associated them with Catesby's *Natural History* 1-66. We have changed the identification of each specimen to *Clethra tomentosa* Lam. on the basis of the specimens' short petioles and tomentose abaxial leaf surfaces. Plate 1-66 depicts *C. alnifolia*; the long style is clearly distinguishable on the image. The foliage illustrated is ambiguous but the engraving definitely has long petioles.

The current lectotype for *Clethra alnifolia* as designated by Sleumer, housed in the Linnaean Herbarium (NHM 2013, see image HL567.1) is definitely representative of *Clethra tomentosa* (Sleumer 1967). *Clethra alnifolia* has been variously treated as containing strictly those plants with glabrous leaves and longer petioles or containing both this form and the form representing *C. tomentosa*. Tucker and Jones (2008) and Weakley (2012) both recognize *C. tomentosa* as distinct. If we are to conserve the current usage of *C. alnifolia* as applying to the glabrous material with long petioles that is and has been in common usage, a new lectotype may need to be designated. The color plate 1-66 in *Natural History*, which depicts *C. alnifolia*, could possibly serve as a lectotype to conserve the current use of the name.

Clarification of determinations

Careful examination of the digital images has allowed us to refine the determinations of some of the previously identified specimens. For example, H.S. 232 f. 14 contains a specimen labeled *Quercus prinus* L. We believe that this, most likely, is a specimen of *Q. michauxii* Nutt. The name *Q. prinus* L. has been historically applied to multiple members of the chestnut oak group and has led to some confusion as to whether it is meant to apply to the species currently divided into Q. *montana*

---

[5]Several specimens are marked with Reveal's Linnaean Plant Name Typification Project labels. These are H.S. 212 f. 13 *Gordonia lasianthus* (L.) Ellis; H.S. 212 f. 16, *Calycanthus floridus* L.; H.S. 212 f. 61, *Catalpa bignonioides* Walt.; H.S. 212 f. 66 *Oxydendrum arboreum* (L.) DC.; H.S. 232 f. 51 *Catalpa bignonioides* Walt.; H.S. 232 f. 50 *Gordonia lasianthus* (L.) Ellis; H.S. 232 f. 57 *Oxydendrum arboreum* (L.) DC. H.S. 323 f. 122 *Endodeca serpentaria* (L.) Raf.

and *Q. michauxii*. Distinguishing species solely on the basis of mature leaves is difficult. Nixon (1997) noted that "attempts to identify these species mostly or solely on basis of leaf shape and dentition (as in many other oak species complexes) have resulted in a plethora of misidentified material in herbaria and erroneous reports in the literature." The specimen in question contains only mature leaves, with no fruits that would make identification more straightforward.

Based on what we know of Catesby's travels and his own description of the "Chesnut-Oak" in his Natural History, however, we believe it unlikely that Catesby would have encountered *Q. montana* except perhaps at the very limit of his travels near the mountains. Weakley describes *Q. montana* as "primarily Appalachian" in its distribution. Catesby said of the Chesnut-Oak that it "grows only in low and very good land, and is the tallest and largest of the Oaks in these parts of the World: the Bark white and scaly...." (*N.H.* 1-18). Also see Weakley's description of the habitat of *Q. michauxii*: "Bottomland forests, especially in fertile soils of upper terraces where flooded only infrequently and for short periods, upland depression ponds." In his key, Weakley describes the bark of *Q. michauxii* as "light gray, loose, breaking into plates or scales" (2011). It seems quite likely that the tree Catesby observed was the same type that Weakley identifies as *Q. michauxii*.

H.S. 212 f. 1 contains a specimen of *Persea palustris* (Raf.) Sarg.. Howard identified it *in sched.* as *Persea borbonia* (L.) Spreng. and associated it with Catesby i63. Weakley describes *Persea palustris* thusly: "Twigs densely rusty-pubescent; lower surfaces of leaves with longer, rusty, often crooked hairs, not appressed, especially evident along the midrib and principal veins; peduncles 4-7 cm long; leaves tending to be larger and more acute;" and *P. borbonia* thusly: "Twigs glabrous or glabrate; lower surfaces of leaves with minute, silvery to shining-golden hairs (the color depending on age), appressed to the surface; peduncles 1-3 cm long; leaves tending to be smaller and blunter." Catesby's plate and his description make it clear that he was describing *Persea palustris*, not *Persea borbonia*. Both the watercolor and the dried specimen have long peduncles, characteristic of *P. palustris*, and Catesby described the plant as growing in low swampy lands. According to Weakley, *P. palustris* grows in swampy areas and wet peaty soils and *P. borbonia* in dry sandy soils. We conclude based on this that the specimen on H.S. 212 f. 1 must in fact be *P. palustris*.

Catesby collected two pitcher plants of the genus *Sarracenia*. H.S. 212 f. 20 contains a specimen of *Sarracenia rubra* Walt. Howard identified it as *S. x catesbaei*, but the specimen does not have the distinctive morphology associated with *S. x catesbaei* so it must be *S. rubra*. Likewise, H.S. 212 f. 21 is neither *Sarracenia x catesbaei* nor *S. flava* but instead is *S. minor* Walt.[6] This was also determined in 1906 by J.M. MacFarlane, emeritus professor of botany at the University of Pennsylvania, who noted his determination in pencil next to the specimen.

Geography/Catesby's travels

We know that Catesby installed himself in Charleston, or as he called it, "Charles Town,"[7] in 1721. From there he explored the Savannah River, the coastal plain, the sandhills, and made his way up as far as the foothills of South Carolina. In a letter to Sloane, he mentioned collecting plants "300 miles from the mouth of Savanno (*sic*) River a very pleasant Hilly country infinitely excelling the inhabited parts both for goodness of land and air resembling the best parts of Kent but in some places

---

[6]It appears that Mark Catesby may not have collected a specimen of his namesake pitcher plant, *Sarracenia x catesbaei*. Stephen Harris sent us images of the four *Sarracenia* specimens at Oxford; one is *S. rubra* and the other three appear to be *S. minor.*

[7]The city today known as Charleston, South Carolina, was called Charles Town from about 1670 to 1783, when it adopted the current shortened name.

affording much larger Prospects" (Dandy 1958). Beyond that, however, modern chroniclers do not have access to precise travel routes visited by Catesby. The state of mapping in the Carolinas in the early 18th century was such that it is virtually impossible to reconstruct his movements with any accuracy other than to presume his routes would have followed major trade routes and military routes, at least as far as Fort Moore in present-day Aiken County.

Catesby's collections, however, may provide insight into the extent of his travels. The habitat preferences of many species are extremely specific and they often occur only in discrete or restricted regions of South Carolina and Georgia. If we assume that it is most likely that species restricted to the Piedmont on high-calcium soils or the lower Blue Ridge have always been thus restricted, we can make calculated predictions about particular places Catesby is likely to have visited.

Of course it is always possible that Catesby received a specimen in trade or that the range of various species has changed over the past three centuries as a result of climate change. We have no way of knowing for certain that he himself collected every specimen with his own hands. However, the most likely explanation for the presence of a plant in his collection is that he did collect it in person from its wild habitat, and so our discussion here is based on that assumption.

Based on the plants he collected, Catesby appears to have traveled from Charleston to Beaufort and then traveled Creek Indian trails possibly as far as Clemson. His plant specimens indicate that he must have visited the upper Savannah River region, the sandhills, the piedmont, and probably as far upstate as Oconee County. For example, Catesby collected *Litsea aestivalis* (L.) Fern. (H.S. 232 f. 35), which grows on the margins of limesinks and Carolina bays; so Catesby must have explored the distinctive habitats of coastal plain pond cypress depressions.

Several specimens must have come from the upper Savannah River region. *Thalictrum revolutum* DC., on H.S. 212 f. 29, is not prevalent in the sandhills or coastal plain of South Carolina, but it is abundant in the prairie remnants of the upper Savannah River in the Piedmont. *Brunnichia ovata* (Walt.) Shinners, H.S. 232 f. 101, grows only along the Savannah river in this region. *Baptisia bracteata* Elliott, H.S. 212 f. 20, is most abundant and essentially restricted to the Savannah River corridor counties of the piedmont in South Carolina — another indication that Catesby's route took him along this corridor. H.S. 212 f. 20 also contains a specimen of *Coreopsis lanceolata* L.; on that page Catesby is rebuilding the composition of the Savannah River Basin plant population.

Other specimens probably came from the Sandhills region, in modern Aiken and Lexington counties. A group of these specimens is clustered in the same region of H.S. 212, from folios 30 to 41. These include all the specimens on f. 30, *Nolina georgiana* Michx. (H.S. 212 f. 32), *Berlandiera pumila* (Michx.) Nutt. (H.S. 212 f. 34), *Allium cuthbertii* Small (H.S. 212 f. 36), and *Pediomelum canescens* (Michx.) Rydb. (H.S. 212 f. 41). H.S. 212 f. 57 contains a specimen of *Commelina erecta* L., a species from dry sandy habitats and dry rock outcrops. All of these are known primarily from the deep sands of the fall-line of South Carolina. *Delphinium carolinianum* Walt., H.S. 212 f. 59, is known from sandy soils in Aiken County and historically from McCormick County. This plant is extremely uncommon in South Carolina today and probably was historically as well; it is more common in the lower Midwest.

Moving further upstate into the Piedmont, *Polygala polygama* Walt. (H.S. 212 f. 31) is uncommon in the coastal plain but more numerous in the upper and middle Piedmont. *Sericocarpus asteroides* (L.) B.S.P. (H.S. 212 f. 35) is a species mostly restricted to the Piedmont and Blue Ridge provinces in South Carolina.

Finally, Catesby appears to have visited the Blue Ridge escarpment region during early summer. For example, *Lysimachia fraseri* Duby (H.S. 212 f. 36) has never been collected below the base of the Blue Ridge escarpment and thus it could be that Mr. Catesby travelled up the Savannah River drainage at least as far as central Oconee County, South Carolina. *Collinsonia canadensis* L., H.S. 232 f. 75, occurs primarily in the upstate, in the piedmont and mountains, in cove forests and rich forests over calcareous or mafic substrates (Weakley 2012; USDA, NRCS 2013), so Catesby must have visited that type of habitat, quite possibly in Oconee County. *Osmorhiza longistylis* (Torr.) DC. (H.S. 212 f. 32) is a species limited to high pH soils of rich forests. H.S. 212 f. 12 contains a specimen of *Prunus caroliniana* Ait., with the note that "it grows no where less than 200 miles from the Sea." H.S. 212 f. 55 contains a specimen of *Hydrangea arborescens* L. in full bloom; this species mostly occurs in the upstate, near the North Carolina border. H.S 232 f. 55 contains a specimen of *Hydrangea radiata* Walt., a southern Appalachian endemic often found in the escarpment gorge region straddling the borders of South Carolina, North Carolina, and Georgia. All of these specimens suggest that Catesby reached the upstate.

We encountered some geographic mysteries. For example, H.S. 212 f. 29 contains a specimen of *Stachys*. John Nelson suggests that it could be either *S. hispida* Pursh or *S. eplingii* J. Nelson. The other specimens on the same and nearby folios (*Thalictrum revolutum*, *Baptisia bracteata*, *Coreopsis grandiflora, Coreopsis lancifolia*) all appear to have been collected from the upper Savannah River drainage, modern McCormick and Greenwood Counties. Nelson (pers. comm. 2012) does not know of either *S. hispida* or *S. eplingii* occurring in that part of the state; Weakley writes that *S. eplingii* "has a scattered and sporadic range in the southern and central Appalachians." So where did Catesby find this plant? (Of course, the placement of this specimen on that particular page could have been completely random; it is important not to read too much into specimen layout.).

Native range

Many species that are distributed throughout the Southeast today have obscure Pre-Columbian native distributions. The plants in H.S. 212 are entirely from "Carolina," so they must have been growing in South Carolina or perhaps Georgia. H.S. 232 is less clear because it mixes specimens from the Bahamas and Florida with Carolina material. Although questions of nativity are inevitably complicated by having to decide exactly when a plant must have been growing in an area to be considered "native" rather than "introduced," we can say conclusively that if Catesby collected a plant, it must have been growing in one of the regions he visited between 1721 and 1726.

For example, H.S. 212 f. 14 contains a specimen of *Acer saccharinum* L. (we have identified it on the basis of its heavily dissected silvery leaves and believe Howard's identification of this specimen as *Acer rubrum* L. is incorrect). Weakley claims that this plant is "rare and mostly introduced east of the Appalachians and south of Virginia." Catesby's collection is evidence that at least one specimen was growing in South Carolina, likely in the coastal plain, in the early 1720s. Likewise, Weakley suggests that *Sida rhombifolia* L. (H.S. 212 f. 50) was introduced into the Carolinas. This specimen shows that it was growing in the Carolinas in the 1720s, though it may have been introduced from European settlers passing through Barbados. *Gleditsia triacanthos* L. (H.S. 212 f. 61), *Triodanis perfoliata* (L.) Nieuwl. (H.S. 212 f. 31), and *Gamochaeta antillana* (Urb.) Anderb. (H.S. 212 f. 35) all appear in this collection; while we cannot say that they are all native to Carolina, we can say that they were most likely growing in Carolina in the 1720s.

Catesby collected at least two separate specimens of *Catalpa bignonioides* Walt., H.S. 212 f. 61, H.S. 232 f. 51. A color plate of this species also appears at 1.49 in the *Natural History*. The native range of this species is most frequently listed as the east Gulf Coastal Plain, extending east only into southwestern Georgia and Florida. According to Weakley and other authorities, this plant had a native range well south of any area visited by Catesby, though most do note that nativity is

difficult to ascertain because the tree was so widely planted by settlers starting in the late 1700s. The species was extensively planted by the late 18th century for its pleasing flowers and exotic foliage and wood and thus was spread far beyond its native range, naturalizing as far north as Connecticut and Michigan (Weakley 2011). The Carolinas are not listed in the native range of this species by any modern author. The collections made by Catesby may provide additional evidence in support of its status as a native element of the Carolina flora.

Catesby likely collected these plants along the Savannah River in the Piedmont or upper coastal plain of South Carolina or perhaps Georgia in 1724. He states they were growing far from the settlements; his note to Sloane attached to H.S. 212 f. 61 reads, "They grow by River sides very remote from the Settlements in rich land." The Native Americans Catesby met certainly knew the plant; on his note to Sloane accompanying the specimen, he labeled the plant, "Catalpa called so by the Indians." He remarked that his collection predates their widespread use in landscapes in the South. We believe this indicates that *C. bignonioides* should be presumed native. While it is possible that the plant escaped from Native American use, it cannot be presumed that it was not native to the Piedmont of the Carolinas.

Further evidence to support this comes from the fact that a specimen on folio 28 of the collection of John Fraser termed the "Thomas Walter Herbarium" (f. 28) was also likely collected from the Savannah River as the plants Mr. Fraser took to Thomas Walter were collected during his voyage (partly accompanied by Andre Michaux) up the Savannah River drainage. Though a perfectly suitable specimen exists in the Fraser collection, which quite possibly was examined by Thomas Walter, Daniel Ward chose to neotypify this species with a recently collected specimen from Lexington County, South Carolina (Ward 2007). It is appropriate that the neotype is also from South Carolina.

Another *Catalpa* specimen is in the Catesby collection at Oxford University; this specimen was identified as *Catalpa speciosa* Walter by Joseph Ewan in 1955. We believe that this specimen might also be *Catalpa bignonioides*, based on the fact that Catesby could not have encountered *C. speciosa* in the 1720s.[8] Weakley describes the range of *C. speciosa* as "native in the upper Mississippi River Embayment of s. IN and s. IL, south to w. TN and e. AR; early naturalized in a more widespread area" (Weakley 2011). Europeans had not ventured anywhere near the native range of this species at the time Catesby visited the Americas. While it is geographically plausible that *C. bignonioides* could have occurred slightly farther north in the Coastal plain area than has traditionally been believed, it is unlikely that *C. speciosa* could have been found hundreds of miles east and on the other side of the Appalachians from its historic range.

Catalpa was apparently sent back to England and presumably grew in gardens there long before its more well-known introduction into European landscapes by Michaux's associate Saunier in the late 1700's (Robbins & Howson 1958). In the *Natural History* Catesby states: "This Tree was unknown to the inhabited parts of *Carolina*, till I brought the Seeds from the remoter parts of the Country. And tho' the Inhabitants are little curious in Gardening, yet the uncommon Beauty of the Tree has induc'd them to propagate it; and 'tis become an Ornament to many of their Gardens, and probably will be the same to ours in England, it being as hardy as most of our American Plants; many of them now at Mr. Christopher Grays, at Fulham, having stood out several Winters, and produced

---

[8]According to Stephen Harris, curator of the Oxford University Herbaria, the seed pods of this specimen are 22 cm long, 13 mm wide across the pod at the widest point, and 10 mm thick. Weakley describes *Catalpa bignonioides* as having pods 6-10 mm thick, each valve 9-15 mm wide when flattened. *Catalpa speciosa* has pods 10-15 mm thick and valves 13-18 mm wide.

plentifully their beautiful Flowers, without any Protection, except the first Year." It is quite possible that whether from Fraser, Michaux, or Catesby, most of the landscape and escaped material of this species originated from South Carolina and now it would appear that South Carolina should indeed be considered part of the natural range for this species.

Economic botany

Catesby was clearly interested in many aspects of the plants he collected, including their practical uses. For example, on H.S. 232 f. 31 is the following note, pasted below a specimen of *Smilax auriculata* Walter: "This I think is a kind of Smilax. It's called here China Root and is much in use for Dyet Drinks and is of great esteem for its virtues." Members of the genus *Smilax* have long been used as folk medicines to cure various ailments, from rheumatism to syphilis. Europeans and Americans both used the plants (Amira et al. 2012). *Smilax* also goes by the name sarsaparilla, which was a popular drink in the days of soda fountains (USDA, ARS 2013). *Smilax china*, sometimes commonly known as china root, has recently been proven a useful treatment for kidney ailments (Chen et al. 2011). So Catesby was right on all counts – identification, common name, and "virtues" – though his use of the term "dyet drinks" differed from the modern meaning, and he used it to refer to a healthful tonic or medicine rather than a low-calorie beverage.

Catesby had at least a passing interest in rattlesnakes. In his *Natural History* he devoted an entire page (*N.H.* 2-41) to snakes, most of it to the "Rattle-Snake," of which he wrote "Of these Vipers the Rattle-Snake is most formidable, being the largest and most terrible of all the rest." He described in some detail the dire effects of rattlesnake bites, and the treatments of bites deemed survivable. (If someone was bitten with full force of the deadly fangs, inevitable death would ensue, as Catesby claimed to have "often seen.") A non-deadly bite, however, merited treatment and Catesby described several botanical cures. He wrote that the treatment "which they rely on most, and which most of the Virginian and Carolina Indians carry dry in their Pockets, is a small tuberous Root, which they procure from the remote parts of the Country; this they chew, and swallow the juice, applying some to the Wound." H.S. 232 f. 105 contains a specimen of *Aletris aurea* Walt. and the note: "The Root of this plant the Indians esteem good for the Bite of the Rattlesnake." Could this be the same root Catesby describes in the *Natural History*?

The sweep of history

The two volumes of Catesby's Sloane collections contain much more than just herbarium specimens. On their pages, they depict a scientific conversation that has been in progress for over three centuries. Sloane's handwritten notes, placed around the late 1720s or 1730s, refer back to John Ray, who published his history of plants between 1686 and 1704. Solander's labels, added in the 1760s or 1770s, incorporate some Linnaean identifications and show Solander's own efforts at independent identifications. In 1982 Richard Howard, Harvard botanist and director of the Arnold Arboretum, visited the Sloane and added typewritten labels containing modern identifications to the specimens that corresponded to plates in the *Natural History*. In 1992 the great botanist and Catesby scholar James Reveal contributed his own labels for the Linnaean Plant Name Typification Project. Along the way other scholars added notes in pencil.

These scholars placed their notes directly on the folio pages. If they had not, their contributions would not be available to us today. We hope, however, that our contributions to this ongoing discussion will become part of the record despite the fact that we are posting them online instead of pasting them into the volumes in London. This is one of the main purposes of our project – to expand the scope of analysis of these historic specimens and allow for many interconnected observations and debates without having to interfere with the physical artifacts.

Botanica Caroliniana: Integrated, collaborative research

Biological collections, including herbaria, have huge potential for research in systematics, ecology, and evolution (Pyke & Ehrlich 2010; Donaldson 2009). Researchers have used herbaria to track the spread of species and for phenological changes that could indicate a changing climate (Primack & Miller-Rushing 2009); to monitor the movement of invasive species (Aikio et al. 2010); to study phylogenetic variation and past geographic distribution of crop landraces (Lister et al. 2010); and to reconstruct the population structure and extinction risk of plant species known primarily from herbarium specimens (Rivers et al. 2010). Herbaria may be the next frontier of species discovery; a group of researchers from the United Kingdom and Missouri Botanical Garden recently found that a large number of undescribed species have already been collected and stored in herbaria but still await description (Bebber et al. 2010). In 2009, researchers searching in various major herbaria unearthed 24 specimens, including several types, collected by Charles Darwin on the voyage of the HMS Beagle (Porter et al. 2009).

Lack of information hampers research in natural history collections. Botanic gardens, for example, by and large do not have good information on the species living within their bounds or have not cataloged that information in such a way that it is easily shared (Pautasso & Parmentier 2007). Herbaria likewise are not well documented and often receive specimens faster than they can be classified (Bebber et al. 2010). Information sharing through databases is essential if biological collections are to reach their true potential and to become relevant to the general public (Pyke & Ehrlich 2010).

The digital imaging project that produced the images of the Catesby *Horti Sicci* is a collaboration by scholars from Clemson University, Furman University, and the Natural History Museum London to digitize the herbarium collections of the first naturalists to study the botany of the Carolinas: Mark Catesby, Robert Ellis, John Lawson, John and William Bartram, James Oglethorpe, and Thomas Walter. We secured 2,000 images of plants, some collected as early as 1710. The images are under Creative Commons license freely available for all non-commercial uses. We have begun to expose this data using the networked services of the CITE Architecture.[9] This digital library infrastructure developed for and by the Homer Multitext Project, of which one of the authors, C. Blackwell, is an Editor.[10] It is based on open content data treated generically. The architecture allows discovery and retrieval of data through public APIs, without limiting how the data is otherwise exposed. It is entirely implemented in freely available software, and has been successfully used to expose a very large body of complex data to end-user applications for the interdisciplinary study of ancient Greek manuscripts.[11]

The *Botanica Caroliniana* project aims to address this deficiency by making collections available to any user, anywhere, at any time. High-resolution photographs posted on a server are easily accessible by any user with a good connection. The images we have posted of Catesby's collections are zoomable, allowing examination of small details such as pubescence, stamens, or faint handwriting. The digital library infrastructure allows "quotation" of images, that is, reproduction of portions of images by means of canonical citation that uniquely identify a region-of-interest while

---

[9]<http://folio.furman.edu/projects/botanicacaroliniana>

[10]<http://www.homermultitext.org> How a technology developed for a purely humanist project is suited to an interdisciplinary, largely scientific project is discussed at this project's blog: <http://botanicacaroliniana.blogspot.com/2011/12/borrowing-from-homer-data-model-for.html>.

[11]For example, <http://folio.furman.edu/lichfield>.

providing access to the larger context of the whole image (Blackwell & Blackwell 2011). The primary source material is now available for anyone to examine. With traditional methods of herbarium and library storage, only a user who can visit the herbarium or borrow the specimens can examine them. Everyone else must trust that that scholar's interpretation of what he saw was correct.

This has been the case with both natural history specimens and antique books, including Catesby's *Natural History*. Howard wrote in 1983 "Since the facsimile reproduction and the text have not been widely distributed and no reprints of the folio-sized text are available, we believe that the following lists and comments should be useful" (Howard & Staples 1983). Access was much better for James Reveal in 2009; in his revisiting of Catesby's *Natural History*, he had access to several online facsimiles of the work as well as a number of Linnaean types that have been digitized as part of the Linnaean Plant Name Typification Project (Reveal 2009). Access to the *Natural History* is excellent compared to access to Catesby's herbarium specimens in the Sloane Herbarium; until we posted the images online, anyone wishing to examine them had to visit London. A scholar with a particular purpose in mind had to focus on the task at hand and could not afford to examine other specimens; for example, Richard Howard published only the specimens of species that appear in *Natural History*.

The actual objects will always be valuable and we are certainly not suggesting that photographs of whatever resolution can replace the dried plants themselves. But for identification, and for examining the various texts on the pages, photographic images are ideal. The user can view them at any time, anywhere, and in combinations that are not possible with the real items. This allows for a much greater range of work, and for unexpected synergistic finds.

ACKNOWLEDGEMENTS

We would like to thank the following: John B. Nelson of the Moore Herbarium, University of South Carolina; Charlie Jarvis of the Sloane Herbarium, Natural History Museum London; Stephen Harris, Druce Curator of the Oxford University Herbaria; Dixie Damrel, Curator, Clemson University Herbarium; and Ryan Baumann, Computer Scientist, The University of Kentucky's Center for Visualization and Virtual Environments.

Some of the work described here is funded by the National Science Foundation under Grants No. 0916148 & No. 0916421. Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation (NSF).

LITERATURE CITED

Aikio, S., R. Duncan, and P. Hulme. 2010. Herbarium records identify the role of long-distance spread in the spatial distribution of alien plants in New Zealand. J. Biogeogr. 37: 1740–1751.

Allen, E. 1937. New light on Mark Catesby. The Auk 54: 349–363.

Bebber, D.P., M.A. Carine, J.R.I. Wood, A.H. Wortley, D.J. Harris, G.T. Prance, G. Davidse, J. Paige, T.D. Pennington, N.K.B. Robson, and R.W. Scotland. 2010. Herbaria are a major frontier for species discovery. Proc. National Acad. Sci. <http://www.pnas.org/content/early/2010/12/01/1011841108>

Blackwell, C. and A.H. Blackwell. 2011. Image "Quotation" Using the C.I.T.E. Architecture <http://www.ariadne.ac.uk/issue67/blackwell-hackneyBlackwell/ Ariadne>

Catesby, M. 1754. The Natural History of Carolina, Florida and the Bahama Islands. <http://digital.library.wisc.edu/1711.dl/DLDecArts.CateNatHisV1> Digital Library for the Decorative Arts and Material Culture, Univ. of Wisconsin, Madison.

Chen, L., H. Yin, Z. Lan, S. Ma, C. Zhang, Z. Yang, P. Li, and B. Lin. 2011. Anti-hyperuricemic and nephroprotective effects of *Smilax china* L. J. Ethnopharm. 135: 399–405.

Dandy, J.E. (ed.). 1958. The Sloane Herbarium. Trustees of the British Museum, London.

Donaldson, J.S. 2009. Botanic gardens science for conservation and global change. Trends Pl. Sci. 14: 608–613.

Frick, G.F. and R.P. Stearns. 1961. Mark Catesby: The Colonial Audubon. Univ. of Illinois Press, Urbana.

Gilbert, L.A. 2013. Daniel Solander (1733–1782). Australian Dictionary of Biography, National Centre of Biography, Australian National University. <http://adb.anu.edu.au/biography/solander-daniel-2677/text3741>

Howard, R.A. and G.W. Staples. 1983. The modern names for Catesby's plants. J. Arn. Arbor. 64: 511–546.

Jarvis, C. 2007. Order Out of Chaos: Linnaean Plant Names and Their Types. The Linnaean Society of London.

Lister, D., M. Bower, and M. Jones. 2010. Herbarium specimens expand the geographical and temporal range of germplasm data in phylogeographic studies. Taxon 59: 1321–1323.

Nixon, K.M. 1997. *Quercus* sect. *Quercus* (Fagaceae). Pp. 471–506, *in* Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and Oxford

NHM. 2013. Linnaean Plant Name Typification Project. The Natural History Museum (BM), London. <http://www.nhm.ac.uk/research-curation/research/projects/linnaean-typification/>

Pautasso, M. and I. Parmentier. 2007. Are the living collections of the world's botanical gardens following species-richness patterns observed in natural ecosystems? Bot. Helv. 117: 15–28.

Porter, D., G. Murrell, and J. Parker. 2009. Some new Darwin vascular plant specimens from the Beagle voyage. Bot. J. Linn. Soc. 159: 12–18.

Primack, R.B. and A.J. Miller-Rushing. 2009. The role of botanical gardens in climate change research. New Phytol. 182: 303–313.

Pyke, G. and P. Ehrlich. 2010. Biological collections and ecological/environmental research: a review, some observations and a look to the future. Biol. Rev. 85: 247–266.

Reveal, J.L. 2012. A nomenclatural summary of the plant and animal names based on images in Mark Catesby's Natural History (1729-1747). Phytoneuron 11: 1–32.

Reveal, J.L. 2009. Identification of the plant and associated animal images in Catesby's Natural History, with nomenclatural notes and comments. Rhodora 111: 273–388.

Rivers, M., S. Bachman, T. Meagher, E. Lughadha, and N. Brummitt. 2010. Subpopulations, locations and fragmentation: Applying IUCN red list criteria to herbarium specimen data. Biodiv. Conserv. 19: 2071–2085.

Robbins, W. and M.C. Howson. 1958. André Michaux's New Jersey garden and Pierre Paul Saunier, journeyman gardener. Proc. Amer. Philos. Soc. 104: 351–370.

Sleumer, H. 1967. Monographia Clethracearum. Bot. Jahrb. Syst. 87: 36–116.

Tucker, G.C. and S.C. Jones. 2008. Clethraceae. Pp. 364–366 *in* Flora of North America North of Mexico, Vol. 8. Oxford Univ. Press, New York and Oxford.

USDA, ARS. 2013. National Plant Germplasm System. Germplasm Resources Information Network (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. <http://www.ars-grin.gov/npgs/index.html>

USDA, NRCS. 2013. The PLANTS Database. National Plant Data Team, Greensboro, North Carolina. <http://plants.usda.gov>

Ward, D.B. 2007. Thomas Walter Typification Project, IV: Neotypes and epitypes for 43 Walter names, of genera A through C. J. Bot. Res. Inst. Texas 1: 1091–1100.

Weakley, A.S. 2012. Flora of the Southern and Mid-Atlantic States. Working draft of September 2012. Univ. of North Carolina Herbarium (NCU), Chapel Hill. <http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2012-Sep.pdf>